DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

METAL FINISHING

OCTOBER, 1950 VOLUME 48 • NUMBER 10

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COMING SOON

The story of a newly developed coating for aluminum that gives this metal the surface hardness comparable to chrome plating.

Methods for setting up a rate system in polishing operations using the Elemental Time Standards system.

A series of articles on the significance and measurement of surface properties important in levelling and plating work.

Detailed discussion on setting up and heading polishing wheels for long and economical service life.

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ESTABLISHED 1903

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A Report On Plating Shortages

The most amazing event since the start of the Korean War, as far as the plating industry is concerned, has been the rapidity with which plating metals and chemicals have become scarce, and in some cases at least, virtually non-existant. Instead of the anticipated curtailment of plating activities by government decree we find many plating plants where production is seriously threatened by material shortages alone, the most acute of which are nickel anodes, nickel salts, chromic acid, all alkalies, cadmium, and tin.

Considerable confusion seems to exist as to the reasons for the rapidity with which shortages developed, and many have been wondering if hoarding or black market operations were responsible. From all reliable indications neither of these seem to be a factor.

The best explanation seems to lie in the extremely close ratio of supply and demand, coupled with the low inventories maintained on hand in plating shops up to the outbreak of the Korean War. It should be realized that our production was rolling along in high gear and at unprecedented levels even before the start of the "lukewarm war," with manufacturers of plating chemicals operating at maximum output and users buying and using for immediate needs only. It was a period of rising prices and unpredictable operations that made maintaining of large inventories unwise. Any interruption of the primary supply was therefore immediately reflected down the line to the user.

Government stockpiling necessities quickly siphoned off nickel and tin, and because production of both of these was already at a maximum and could not be stepped up, an immediate shortage developed. It was not a case of government rationing, but simply a case of less metal being available for non-military uses. Under such conditions there can be no argument against the fair allocation program put into effect by the principal nickel producer. As metallic nickel is used to produce nickel plating salts, a shortage of these salts also resulted almost immediately.

The shortage in alkalies stems from a three month's strike in the major producing plants. Chromic acid requires alkalies in its production and is therefore tied up also. These shortages can probably be eliminated within a reasonable time after the settlement of the strikes, as the basic production is sufficient to take care of anticipated consumption.

Cadmium, a by-product of zinc refining, is controlled by the amount of zinc metal produced. Here is a case where the expanding uses for cadmium metal, both for plating and non-plating, result in a demand-ratio of cadmium to zinc which is much higher than the ratio of recoverable cadmium in zinc ores. A tight supply will probably exist in cadmium for some time. Plating-wise, the two metals are in competition, and we thus have the anomolous situation whereby switching from cadmium to zinc plating, because of a shortage of cadmium, causes an increased demand for zinc which in turn results in more cadmium being produced and made available for plating!

Many platers probably wish that a government rationing plan for all materials in short supply would be started, so that they might get at least a partial fulfillment of their requirements. However, until a full war emergency program is put into effect in Washington such a plan would be impossible, in addition to being illegal. It must rest with those who have supplies available to dole them out in a fair and impartial manner until such time as the shortages are no more, or the government takes over the responsibility of saying whose needs are most urgent.

W. A. Raymond

Editor

Barrel Plating of Lead-Tin Alloys

By L. H. Seabright, *Metallurgical Engineer, Vulcan Stamping & Mfg. Co., Bellwood, Ill.*

Mr. Seabright obtained his B.S. and M.S. degrees from Ohio State. He was formerly connected with Kellogg Switchboard and Supply Co. as Met. Eng., and is a Reg. Prof. Eng. in the State of Illinois.

Introduction

THE plating of alloys is generally considered a rather involved process requiring complicated and extensive control measures. However, during the war when the shortage of lead and tin became critical, the need for a practical method for electroplating of these alloys became obvious. Some work had been done in the past on the plating of low tin-lead alloys, but there was also a need for plating alloys with a composition similar to that of solder.

In the following method of operation, conditions have been so standardized that it is possible to deposit lead-tin alloys ranging from 3% to 60% tin with a high degree of uniformity and with a minimum of control measures.

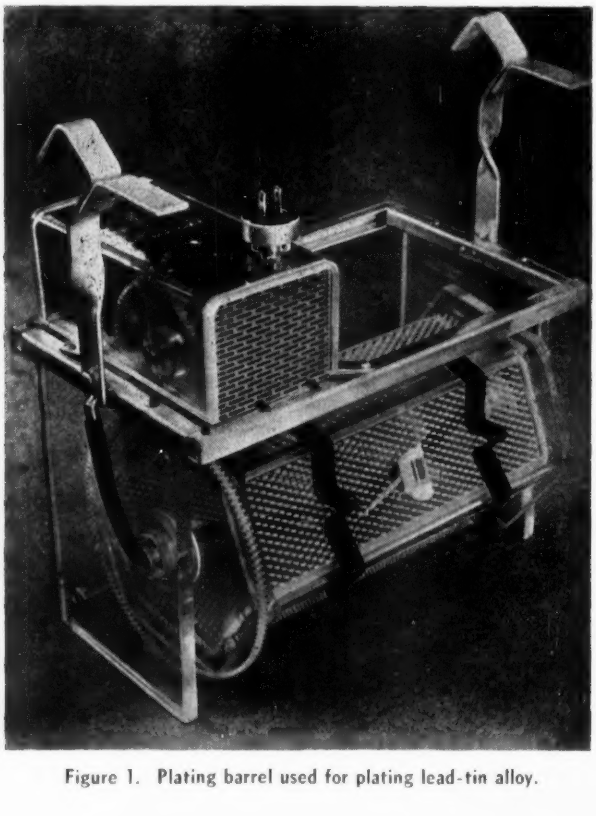


Figure 1. Plating barrel used for plating lead-tin alloy.

Lead-tin alloy may be plated successfully by either using alloy or dual anodes. Alloy anodes are cast of lead and tin, in pre-determined ratios. Dual anodes refer to the use of separate anodes of pure tin and of pure lead, each with its own source of current. For most generaly lead-tin alloy plating, the alloy anode method is preferred because of simpler operation.

Plating Procedure with Alloy Anodes

For plating lead-tin alloy, the two most important variables are: (1) the lead-tin ratio of the alloy anode, and (2), the lead-tin content of the bath. Table I shows the approximate composition of both the anode and the bath recommended for various lead-tin deposits up to 60% tin.

Table I

Composition of Anode and Bath for Various Deposits

Deposit		Anode		Bath					
% Tin	% Lead	% Tin	% Lead	Total Tin Gm. per l.	Stanous Tin G. per l.	Lead Gm. per l.	Free HBF_4, Gm. per l.	Free H_3BO_3, Gm. per l.	Glue Gm. per l.
5	95	5	95	5	4	85	40	25	0.5
7	93	7	93	7	6	88	40	25	0.5
10	90	10	90	10	8.5	90	40	25	0.5
15	85	15	85	15	13	80	40	25	1.0
25	75	25	75	25	22	65	40	25	1.0
40	60	40	60	40	35	44	40	25	3.0
50	50	50	50	50	45	35	40	25	4.0
60	40	60	40	60	55	25	40	25	5.0

The composition of the anode should be the same as that desired for the deposit. In case the resulting deposit does not have the desired composition, any necessary adjustments should be made on the bath composition.

It is most convenient to prepare the plating solution from commercially available concentrates. Typical analyses of these concentrates are shown in Table II.

7% Tin — 93% Lead Alloy Plating

Typical conditions which have been found suitable for plating a 7% tin — 93% lead deposit are shown in Table III.

For example, based on the foregoing analyses of the lead and tin concentrates, and the foregoing suggested composition of the bath, in making up a 100 gal. bath for plating a 7% tin — 93% lead deposit the amounts of ingredients necessary are shown in Table IV.

Table II

Typical Analyses of Concentrates for Lead-Tin Alloy Plating

	Analysis %	gm/l	oz./gal.
Lead Fluoborate Concentrate[1]			
Lead Fluoborate	50.0	934	125.2
Lead	27.5	509	68.2
Free Fluoboric Acid	4.8	89	11.9
Free Boric Acid	5.0	93	12.5
Tin Fluoborate Concentrate[2]			
Stannous Fluoborate	47.0	752.0	100.8
Tin	19.1	306.0	41.0
Free Fluoboric Acid	4.0	64.0	8.6
Free Boric Acid	3.0	48.0	6.4

1—Solution weight is about 15.45 lb. per gal., and sp.gr. 1.85
2—Solutoin weight is about 13.3 lb. per gal., and sp.gr. 1.60

Table III

Bath Composition	g/l	oz/gal
Total Tin	7.0	.94
Stannous Tin	6.0	.80
Lead	88.0	11.79
Free fluoboric acid	40.0	5.36
Free boric acid	25.0	3.35
Glue	0.5	.067

Operating Conditions

pH	0.5 or less (colorimetric)
Temperature	60-100°F.
Current Density	30 amps./sq.ft.
Anodes	7% tin — 93% lead Area of anode and cathode in ratio 2:1.

Table IV

	Pounds	Gallons
Stannous Fluoborate concentrate	30.7	2.31
Lead Fluoborate concentrate	267.6	17.32
Fluoboric Acid (42%)	45.8	3.84
Boric Acid	6.5	.....
Glue	0.42	.....
Water	638.	76.5

The concentrate may be either weighed or measured, as is convenient.

It is recommended that the bath be made up in the following manner: (1) add 50% of required water to tank; (2) add lead fluoborate concentrate; (3) add stannous fluoborate concentrate; (4) dissolve boric acid in a small amount of hot water, add to tank; (5) add fluoboric acid; (6) add glue; (7) add water to volume; (8) operate the solution for a couple hours to remove impurities.

The glue solution is prepared by swelling the dry glue in a minimum of cold water, with stirring, and then raising the temperature to about 140°F. until all the glue is dispersed.

Anode Structure

The ratio of tin to lead and the distribution of the tin in the anodes is important. The foregoing Table I indicates that the percentage of lead and tin in the alloy anodes should be the same as that desired in the deposit. A pure grade of tin and lead should be used. The anodes may be prepared by heating the lead-tin melt to about 750°F. with constant mixing, followed by quick pouring and chilling. Anodes prepared in this manner exhibit a fine grain structure.

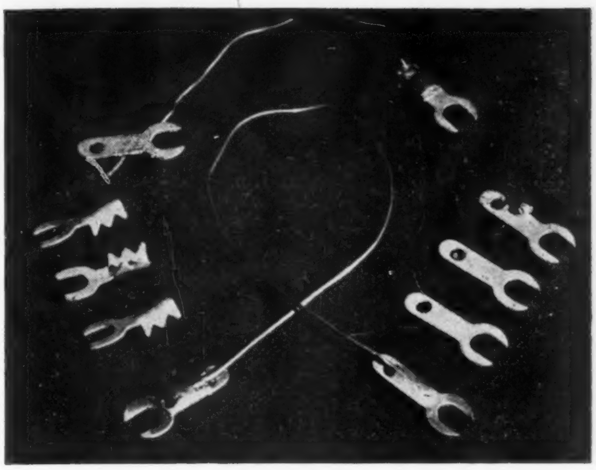


Figure 2. Copper lugs plated with .0002" of 60% Tin—40% Lead alloy.

60% Tin - 40% Lead Alloy Plating

In a previous article,[1] the writer pointed out the advantages of electroplating solder alloys instead of molten solder dipping. The alloy recommended for this application contained 60% Sn and 40% Pb. The conditions shown in Table IV have been found suitable for plating 60% Sn. — 40% Pb.

Table V

Conditions Suitable for Plating 60% Sn - 40% Pb Alloy

BATH COMPOSITION:

	gm./l.	oz./gal.
Total Tin	60.0	8.1
Stannous Tin	55.0	7.4
Lead	25.0	3.35
Free Fluoboric Acid	80.00	10.8
Free Boric Acid	25.00	3.4
Glue	5.00	0.67

OPERATING CONDITIONS:

Temperature—60 to 100°F.
Current Density—30 to 50 amps per sq. ft.
Agitation—Mild (Barrel plating or moving cathode rod)

ANODES:

Composition—60% Sn, 40% Pb
Anode to cathode ratio, 2:1.

Based on the analyses of the lead and tin concentrates and the suggested bath compositions, the amounts of ingredients required to prepared a 100 gal. bath for plating 60% Sn—40% Pb deposit are given below:

	Lbs.	Gallons
Stannous Fluoborate Concentrate	260	19.6
Lead Fluoborate Concentrate	75.5	4.9
Water	.....	65.5
Additions—		
Fluorboric Acid 42%	121.0	10.0
Boric Acid	9.3	.....
Glue	4.2	.....

1. Seabright, L. H., *Iron Age*, 164, No. 23, 93-96 (1949).

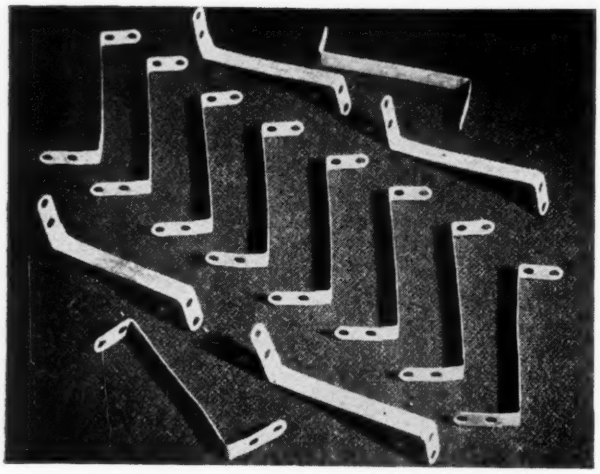


Figure 3. Monel metal angular lugs plated with .0002" of 60% Tin—40% Lead alloy.

Functions of Bath Constituents

The boric acid is added to the solution to maintain stability. Approximately 3.4 oz/gal. boric acid have been found suitable. Free fluorboric acid is maintained in the bath to provide the necessary acidity, to raise the conductivity of the solution, to give a fine-grained deposit, and to prevent treeing. The recommended limits of fluoboric acid concentration are from 5.4 to 10.8 oz. per gal. While this is not considered critical, the higher concentration further increases solution conductivity and throwing power, at the same time reducing anode sludge. These effects are especially desirable in the barrel plating of smaller parts.

Glue is added to the plating solution to promote formation of adherent, fine-grained deposits. A high quality bone glue is recommended for this purpose. In the operation of the solution, there is some breakdown and loss of glue. More glue should be added as evidence of duller deposits is noted. A glue concentration of 0.7 oz. per gal. is usually required for a solution deposition of 60 pct. Sn-40 pct. Pb.

Stannous tin content is one of the important factors in successful operation of the lead-tin bath. If the "stannous" tin decreases, the percentage of tin in the deposit will fall; conversely, a high stannous tin content will result in a higher tin alloy. Mild agitation is important in lead-tin alloy plating, in order to insure uniform deposits. Agitation must not be too vigorous however, as it will cause an increase in the tin content of the deposit. Satisfactory agitation may be provided by barrel plating or cathode rod agitation. The operating efficiency of the process is about 100% for both anode and cathode.

Procedure with Dual Anodes

The dual anode method is capable of more precise control of deposit composition, but also presents a greater number of variables in operation. Under the dual anode method it is necessary to control the surface area of the lead and tin anodes and the current impressed on the anodes, as well as the requirements already given for the alloy anode method.

The tin content of the deposit is controlled by the amount of tin in the solution, which in turn is controlled by the amperage impressed on the tin anode. It is thus possible to control the tin content of the deposit within certain limits by varying the amperage impressed on the tin anode. In placing the tin and lead anodes in the bath, the distance between each should be 2-3".

Barrel Plating

Production runs made by barrel plating lead-tin alloy showed that the same solution compositions were as satisfactory as they had been for still plating. It generally requires about three times as long to plate in a barrel as it does in regular tank plating.

Solution Control Analytical Methods

LEAD

Add 5 cc. of bath to 200 cc. of 10% H_2SO_4 solution.
Boil gently for 10 minutes.
Cool, allow preciptate to settle.
Filter on tared Gooch, wash twice with 1% H_2SO_4.
Dry, place Gooch in a porcelain crucible and ignite at about 1000°F. for 10 minutes.
Cool, weigh.
Calculation: gms. $PbSO_4 \times 136.6$ = Lead (Pb) g/l.

TOTAL TIN

Introduce 5 cc. of sample into a 500 cc. Erlenmeyer flask containing 100 cc. water and 50 cc. of hydrochloric acid.

Introduce 10 grams of iron strip and boil the flask gently for 10 minutes.

Add a few chips of marble ($CaCO_3$) to the flask, stopper the flask and cool in running water.

Titrate fast with 0.1 N Iodine solution to the first 10-second end point.

Calculation: cc. 0.1 N Iodine $\times$ 0.005935 $\times$ 200 = total tin (Sn) grams per liter.

STANNOUS TIN

Stannous tin is determined by titration in the cold with standard iodine.

Introduce 5 cc. of bath into a 500 cc. Erlenmeyer containing 100 cc. of water, 50 cc. of HCl, 5 cc. of .1% starch solution.

Titrate fast with a .1 N Iodine solution to the first ten second end point.

Calculation: cc. 0.1 N Iodine, $\times$ 0.005935 $\times$ 200 = stannous tin (Sn) g/l.

STANNIC TIN

Total tin — stannous tin = stannic tin (Sn) g/l.

pH

The pH of the bath may be checked by means of pH paper.

Analysis of Deposit

For a 10% tin deposit, weigh out approximately a 0.6 gm. sample and transfer to a Erlenmeyer flask. Add 10 cc. strong sulfuric acid, heat until dissolved, cool, add 100 cc. water, 50 cc. of hydrochloric acid and proceed as under total tin.

Calculation:

$$\frac{\text{cc. 0.1 N Iodine} \cdot 0.005935 \times 100}{\text{Weight of sample}} = \% \text{ Tin (Sn)}$$

NOTE: For higher or lower tin alloys, use proportional weight of sample.

In determining the lead in the deposit, tin will have to be removed. In this case the alloy will require dissolution in a 250 ml. beaker with 40 ml. of 1:1 nitric acid, heating to speed the reaction. The solution is now evaporated at low heat to about 5 ml. volume to precipitate all tin. Fifty ml. of 1:1 nitric is now added and the mixture boiled gently for 10 minutes. The beaker is removed from the heat and the precipitate allowed to settle. Filter through a tight filter and wash well with hot water containing 20 ml. of nitric acid per

(*Concluded on page* 72)

Practical Electropolishing of Stainless Steel

By Fred G. Brune,* *Finishing Supt., Marion Industries Div., Motor Products Corp., Marion, O.*

Fred Brune attended the Univ. of Cincinnati, and was associated with Auto-Lite Co. since 1936, except for a period during the War, as finishing foreman and chemical supervisor. He recently took up a new position with Marion Industries.

Introduction

ELECTROPLATING of metals has been the subject of much interest in the finishing field for the past ten years or more. The original hopes of many that it would replace mechanical methods are fading, but the process is now established as another valuable operation to be used by the manufacturing industry.

Electropolished parts attain a smooth, highly light-reflective surface, so that any defects in the metal are made more obvious. On the other hand, mechanically finished parts are covered with microscopic scratches, which tend to diffuse and diffract light, giving a burnished appearance. As long as the standard of acceptance for finished parts is based upon past conceptions, electropolishing will be used mainly for parts having a narrow section or intricate shape.

This article will be limited to a discussion of the procedures used in bringing electropolishing to a successful operation for continuous use in production finishing. It is felt that our experience will be of interest and possible aid to others engaged in the finishing field.

No references will be listed with this article, since published technical articles have covered this field. Many methods are described for electropolishing metals under industrial conditions. Most of those suitable for industrial use are patented and are available for use by agreement.

Preliminary Work

It was our initial desire to finish stainless steel of both the straight chrome and chrome-nickel types. Experiments were conducted in the laboratory on various solutions, and metal samples were submitted to other companies to be finished in their patented baths. Samples from the same lot of steel were finished in nine different types of baths. Our final choice was to use the sulfuric-phosphoric bath, developed by *Battelle Memorial Institute*, since it proved the best for our particular set of conditions. For any particular operation, all available methods should be checked, dependent upon the particular conditions required. In our case, the following factors were important:

(1) The finish must be acceptable to our customers (which usually means similar to a mechanical finish).

(2) Both straight chrome and chrome-nickel stainless steels must be finished equally well in the bath with only a simple variation, such as current density.

(3) Simplicity of operation was necessary from a processing standpoint: that is, a wide range of conditions, such as for anode-to-cathode distance and for time, so that all sizes and shapes can be processed with little or no change.

(4) Simplicity of chemical control and the lowest overall cost of operation for optimum conditions.

The first installation consisted of a 340 gallon tank, which produced work so satisfactorily that it was soon being operated at 20 amps per gallon, 3 shifts per day. The setup was expanded to two 700 gallon tanks, operating on a three shift basis. A new 3800 gallon, semi-automatic machine was then considered.

Continuous operation for electropolishing in a production unit indicated a number of problems differing from those of a pilot line operating on an 8-hour day. To investigate the commercial limits, a test set-up was installed. Sample parts to be used during the test were saved from a lot of steel that was above average in quality.

Influence of Iron Build-up

Plant operations had indicated that iron concentration was an important factor in the operation of a commercial electropolishing bath. Experimental tests were run in a 64 gallon unit to study the iron concentration at selected levels. Current density, time of electropolishing, and temperature were the variables studied, with anode current efficiency and luster-rating used as standards of measurement. The amount and nature of the cathode sludge was also determined. The test program, as set up initially, was to use a new solution and raise the iron concentration by electropolishing stainless steel, and at each one-half per cent increase in iron to make test runs with parts made from types 301 and 430 stainless steel. Samples were to be rated on luster by comparison with the group and assigned a number rating. For each 0.5 per cent increase in iron, the following program was used to obtain information for bath control.

(a) From weight of metal dissolved, calculate theoretical increase in per cent of iron.

(b) By chemical analysis, determine the actual percentage of iron in solution.

**Formerly associated with the Electric Auto-Lite Co., Lamp Div., Cincinnati, O.*

Table 1

Amount of Iron Precipitated as Concentration Increases

Period	*Grams of Fe Dissolved*	*Calculated Fe % Increase*	*Actual Fe % Increase*	*% Fe ppt For Period*	*% Fe ppt Total*
0- .5% Fe	2791	0.747	0.56	25.0	25.0
.5-1.0% Fe	2705	0.712	0.61	14.0	20.0
1.0-1.5% Fe	1705	0.452	0.365	19.3	20.3
1.5-2.0% Fe	2346	0.600	0.505	15.8	20.3
2.0-2.5% Fe	2232	0.590	0.580	1.7	15.5
2.5-3.0% Fe	1092	0.285	0.380	—	14.0
3.0-3.5% Fe	2414	0.673	0.510	25.6	19.1
3.5-4.0% Fe	2143	0.599	0.440	26.5	18.5
4.0-4.5% Fe	2592	0.752	0.580	22.9	19.1

(c) From the above data, determine the amount of iron precipitated.

(d) Analyze the suldge picked up by the cathode to determine the per cent of iron.

(e) Calculate the per cent of precipitated iron picked up by the cathodes.

(f) After the optimum iron concentration is obtained, re-check the effect of variables by holding all constant except one. The items to be checked are temperature, current density, method of agitation, amount of agitation, time, cathode distance, and different metals as cathode material.

(g) Investigate the use of 75% phosphoric acid for additions to bath after it is once in operation. Also, try every possible method for removal of iron from the bath.

The results of this program indicated that iron preciptates as the concentration is increased, but between 2 and 3% iron (by weight) the precipitate redissolves. At 3% iron, or above, about 20% of the dissolved iron precipitates. This number can be used on a commercial basis to calculate iron concentration from amp-hour readings. These data are listed in Table No. 1.

With a new solution, the cathodes pick up a large amount of sludge. As the iron concentration increases less sludge is picked up, until above 2% iron no sludge is picked up when the proper cathode material is used. It is interesting to note that the cathode stops picking up sludge at the same relative percentage that iron precipitation in the bath practically stops. Data on cathode sludge is contained in Table No. 2.

With the sulfuric-phosphoric bath the relationship between voltage and amperage is practically a straight line as shown in Fig. No. 1.

After the test program on iron concentration was completed, the data were summarized as shown in Table No. 3. Since all samples were from the same lot of steel, it was felt that the random effect noted was due to the base metal. This checked with the effects noted on production work, that while one lot of steel may be better than others, the finish within some lots can vary greatly.

Influence of the Metal

The next step was to study the relationship between stainless steel metallurgy and electropolishing results. No attempt will be made to identify the various steel companies, laboratories or individuals who have assisted in gathering the following information.

One of the factors which interested us in the control of mill processing was that the companies furnishing the stainless steel usually mark a preferred side as having a better finish. This is true as to luster and smoothness of the surface of the steel as received. But we found that the opposite side could often be finished easier, by either electropolishing or by wheel work, than the side selected by the mill.

In general, the mill processing, from melting through alloying and rolling, must be such that the finished stainless steel supplied to the customer has a fine, uniform, grain structure, substantially free from all impurities and seams. Chromium carbide is a non-metallic impurity which causes considerable trouble when the material is electropolished. Rolling or cold work (if not excessive) decreases the grain size of the metal and has a leveling effect on the steel. This is indicated, for example, by type 302 steel which becomes slightly magnetic because of cold working, and then gives better electropolishing results.

A test was conducted in cooperation with a steel supplier to investigate mill processing and its effect on the surface as finished by electropolishing. On type 301, the effect of drag polishing, Hamilton grinding, and skin passes were tried individually and in groups.

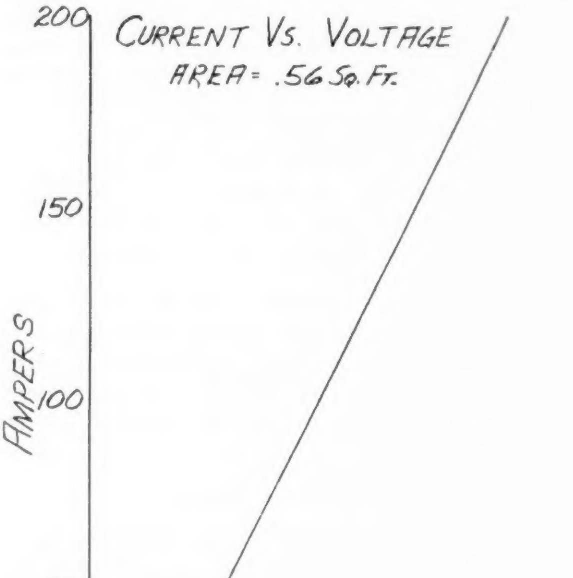


Figure 1. Voltage-amperage relationship in the sulphuric-phosphoric electropolishing bath.

Table 2

CATHODES: Type 317 Steel, in Solution When Operating Only; Area 4 Sq. Ft. (Both Sides); Distance — 8 Inches, Weight at Start — 4 Lbs. 7 Oz.

Period	*Wt. of Sludge on Cathode*	*% Fe In Sludge*	*Lbs. Fe Picked up by Cathodes*	*Lbs. Fe ppt During Period*	*% ppt Fe on Cathodes*
0— 5% Fe	5.5 lbs.	28.1	1.545	1.575	98
.5—1.0% Fe	2.62 "	28.	.744	.835	89
1.0—1.5% Fe	2.0 "	28.	.56	.722	77.6
1.5—2.0% Fe	7 oz.	28.	.135	.9208	14.66
2.0—2.5% Fe	Negligible	28. (Assumed	.002576	.083	3.10
3.0—3.5% Fe	2 oz.	No Analysis	of Sludge		
3.5—4.0% Fe	2 "	" "	" "		
4.0—4.50% Fe	1 "	" "	" "		

For type 430, the same factors plus bright annealing and commercial pickling were also tested.

The various mill samples were then processed through two different electropolishing baths (Armco's and Battelle's processes) and the surface was examined for scratches and luster.

All parts having Hamilton grind operations exhibited deep scratches afer electropolishing. All parts having a drag polish at the mill showed very fine scratches after electropolishing. Parts with no polish or grind, but with a skin pass, were noticeably better. (For the type 403 steel, the commercially pickled samples were better than those given a bright anneal.)

By the time we had completed the above test, we had so many different descriptions of the finished surfaces that we decided to limit the defects to three major groups, plus a consideration of the overall luster of the part for each group. (A rough measure of the luster is to look at a piece and see how well your image is reflected.) All defects were placed in one of three categories:

(1) Pitting
(2) Orange Peel
(3) Lines

Any surface defect on the steel, either imperfection in the base metal itself or a foreign material picked up during fabrication, will cause trouble during the electropolish operation. Such defects will act similar to a "stop off" material, causing a pattern on the finished surface. Each of the three defects will be considered, with the information we have obtained to date.

Pitting

Experience indicates that it is almost impossible to satisfactorily electropolish steel that has a tendency to pit. It also requires more work to polish and buff such a surface by mechanical means, so that the diffi-

Table 3
Rating of Samples on Testing Program

Amp. Min. Rating	A.S.F. & Time = Amp. Min.	.50% L	.50% W	1.0% L	1.0% W	1.5% L	1.5% W	2.0% L	2.0% W	2.5% L	2.5% W	3.0% L	3.0% W	3.5% L	3.5% W	4.0% L	4.0% W	4.01% L	4.01% W	4.50% L	4.50% W
1	400 × 5 = 2000					5	1	7	1	15	1	3½	1	2	1	1½	1	1½	1	1	1
2	350 × 5 = 1750	1	1	1	1	5	2	7	4	5½	2	3½	2	2	2	3	2	3	3	2	2
3	400 × 4 = 1600					1	3	5	3	8	3	3½	3	2	3	1½	3	1½	2	3	3
4	300 × 5 = 1500	2½	6	2½	3	5	4	5	2	5½	6	3½	5	5	5	4	4	4	4	5	4
5	350 × 4 = 1400	2½	5	2½	2	5	5	1	5	2	5	1	4	4	4	9	5	9	5	4	5
6	250 × 5 = 1250	4	2	6	5	5	7	1	6	8	7	10½	9	7½	7	5	6	5	7	7½	7
7	400 × 3 = 1200	6½	10			5	8	1	8	4	13	7	6	7½	8	11	7	11	6	6	6
8	300 × 4 = 1200			4	6	5	6	1	9	2	9	7	8	7½	10	9	9			9	9
9	200 × 6 = 1200	5	3	9	4	5	9	9	7	2	4	10½	7	7½	6	6	8	6	8	7½	8
10	350 × 3 = 1050	6½	13	5	8	12	10	11	12	11	11	10½	12	14½	11	12	11	12	10	12½	11
11	150 × 7 = 1050	14½	4	15	7																
12	250 × 4 = 1000	10	7	8	11	12	14	9	11	11	10	14½	10	11	12	9	12			12½	10
13	200 × 5 = 1000	11	9	10½	9	12	13	13	13	8	8	13	11	11	13	7	10	7	12	10	12
14	300 × 3 = 900	8	15	7	12	12	11	12	14	13½	12	10½	13	14½	14	14½	14	14½	13	12½	14
15	150 × 6 = 900	16	8	16	13																
16	400 × 2 = 800	12½	12			14	12	14	10	16	16	16	14	11	9	16	13	16	14	15	13
17	200 × 4 = 800			12½	10	16	16	16	15	11	14	14½	15	14½	15	13	15	13	15	12½	15
18	250 × 3 = 750	12½	14	10½	15	16	17	18	16	13½	15			14½	18	14½	16	14½	16		
19	150 × 5 = 750	17	11	17	14																
20	350 × 2 = 700	9	17	12½	17	16	15	14	17	18	18	17	17	17½	16	17	17	17	18	16	17
21	300 × 2 = 600	14½	16	14	16	18	18	16	18	17	17	18	18	17½	17	18	18	18	17	17	16
22	250 × 2 = 500																			17	18

L number is the luster rating with the best sample in the group being No. 1.

W number is the weight loss rating with the largest weight loss in the group being No. 1.

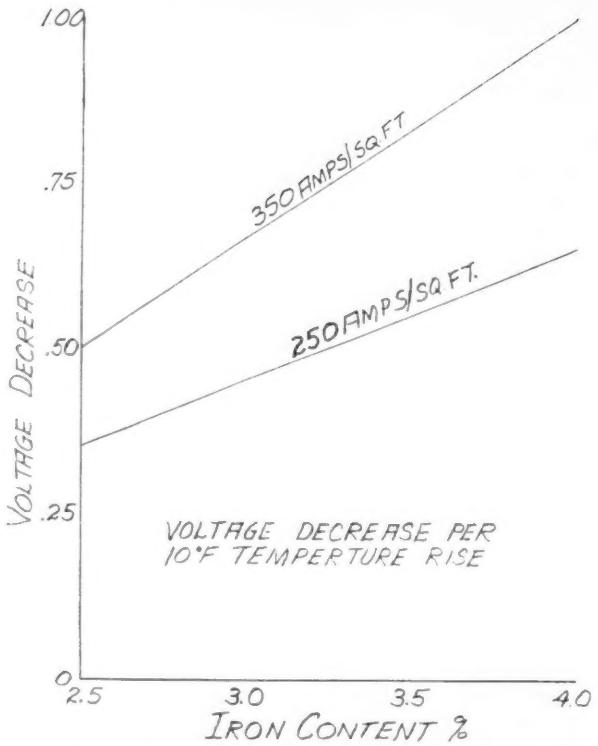


Figure 2. Effect of temperature on the voltage decrease for various current densities and iron contents.

culty affects either electropolish or wheel finishing. (It is our opinion that over-pickling of the stainless steel at the mill is the cause of most pitting.)

Salt baths are used for scale removal by some steel companies, and any salts left on the surface after this treatment will cause pitting during the electropolish operation.

One steel company, called in on a pitted condition found on their product, stated that it was caused by "a surface condition, primarily, contamination created by the rolls in the reduction process." They stated definitely that grain size, chemical analysis, etc. do not cause this pitted condition and that they can control and correct the condition at its source.

Parts with pits were shown to another supplier who stated that this condition could be the result of several causes, i.e.,

(1) High temperature annealing
(2) Decarburization
(3) Excessive pressure during rolling.

Pitting is also associated with steel having non-metallic inclusions, *but* not all "dirty" steel shows pitting.

Orange Peel

On the next major group of defects, orange peel, one supplier who was called in stated that it is due to the cold working of the steel during forming operations at our plant and *was not connected with grain size.* After returning to their plant and checking the samples, they reported to us by letter that on future orders they would eliminate the orange peel effect. Future orders were satisfactory, a clear indication that help from the steel mills will improve electropolish finishing.

Another steel source, whose material showed excessive orange peel, viewed samples at our plant and stated that it was probably due to the metal being too soft. This could occur easily if the annealing temperature was too high at the mill. In other words, the orange peel *was* due to a grain-size condition!

Fine grain size 9 (ASTM Standard) with clean steel usually gives excellent results. With a grain size of 6 the results are usually poor. If the grain size is 7 or 8 the electropolish will be fair or good, depending upon other steel conditions, such as inclusions.

Lines

On the next defect, lines, we discussed earlier that drag polishing and grinding at the mill produced lines in the steel. Also, rolling seams in the steel can cause lines.

In addition to the test above, material from another steel source showed considerable lines after electropolishing. After being notified of the trouble, they changed certain rolling procedures (they would not say how) so that the objectionable lines were held to a minimum. They definitely eliminated the lines on the 300 series steels and improved the condition on the 400 series steels.

The data can be summarized as follows:

Pitting can be caused by electropolishing at too low a current density or with poor current distribution. The steel can cause this defect if it contains non-metallic inclusions, is over-pickled, or is not cleaned before finishing.

Orange peel is caused by a too large grain size with random orientation or else by grain boundary precipitation of carbides.

Lines are due to grinding or drag polishing at the mill, rolling seams, and occasionally strain lines.

Poor luster is caused by a combination of the above. In addition, it is conceivable that poor luster could be obtained because of the existence of complex carbides which do not electropolish at the same rate as the austentic matrix.

We feel that a homogeneous, fine grain structure, and freedom from non-metallic inclusions, rolling seams or precipitated carbides will give the best electropolishing results. Also, in the mill processing, two items, first the pickel and second the cycle of heat treatment in relation to the amount of reduction during the cold passes, are extremely important.

General Observation on Operation

Anode current efficiency falls from an average of 56% to 23% when the iron concentration is increased from 0.5% to 4.5%.

The voltage required depends upon current density and iron concentration. At 200 amps per square foot an increase from 2.0% to 4.5% Fe requires an increase of 4 volts. At 350 amps per square foot, the same change in iron causes an increase of 7 volts. See Figure #2.

At 250 amps per square foot, increasing the anode-to-cathode distance one inch increases the required potential ¼ volt, and at 350 amps, the increase is ½ volt for the same condition. Lead cathodes require ¾ volt more than do types 316 or 317 stainless steel.

Table 4

Choice of Decant Range — Solution Cost per 1000 Square Foot

A visual comparison was made of all samples from all runs that had been polished 5 minutes (see Table #3). Classification was as follows:

A—Satisfactory without color buff.

B—Satisfactory with color buff.

C—Unsatisfactory with color buff.

A graph was then constructed showing the minimum current density required for a five minute electropolish, at a given iron concentration for a given finish. (See Figure 3) Calculations were then made to determine solution cost per 1000 square foot surface finished based on 20% preciptation of dissolved iron.

Finish Classification	*% Fe*	*Amps./ sq. foot*	*Efficiency Anode*	*$/1000t. sq. ft.*
A	0.5	250	59	219.00
A	1.0	250	51	94.80
A	1.5	275	46	64.60
A	2.0	300	40	45.80
B	1.0	150	51	58.40
B	1.5	200	46	46.80
B	2.0	250	40	37.20
B	2.5	300	37	33.90
B	3.0	350	32	28.50
B	3.5	400	27	23.60
C	3.0	200	32	16.30
C	3.5	265	27	15.70
C	4.0	330	25	15.90
C	4.5	400	23	15.00

With a cathode-to-anode area ratio of 7 to 1, doubling the cathode area (14 to 1) lowers the voltage required by ½ volt.

On the production setup, a figure of 20% precipitation can be used to calculate the iron content of the bath from amp-hour readings. The 20% number includes the amount lost in drag out at our plant.

Using type 317 stainless steel cathodes, a heavy sludge (30% iron) was picked up by them when the iron concentration was below 2%. Above 2% the pick up on the cathodes was negligible.

To produce a commercial finish with all parts having the same approximate luster, it is necessary to operate the bath within a certain iron-concentration range. This is accomplished by decanting solution from the tank, the data being listed in Table 4 and Figure 3.

A general note can be made that electropolishing raises the "heat stain" temperature. For example, type 410 steel annealed will "heat stain" at 350-400° F., whereas a sample from the same lot after electropolishing did not "heat stain" until 600°F. For type 302 and 430 steels, after electropolishing, the temperature at which this discoloration took place was increased approximately 70 to 100°F. higher, compared to a wheel finished part.

Practical Operation

Work to be processed should be cleaned prior to being placed into the tank. If the work is not clean, the electropolishing action will not start immediately, so that a "pattern" will be caused by the dirt. Trouble can be caused by scale on the metal (from the mill or during processing), drawing compounds, or oils. Another potential source of trouble is acid flux, if parts are soldered prior to electropolishing. If soldered parts are not neutralized properly, pitting of the surface can occur and will be accentuated during finishing. Steel mills are now also using salt baths, and any such salts left on the steel can cause trouble.

To remove salts after processing and to produce a clean part after electropolishing, the following cycle can be recommended in finishing to good appearance:

Cold Rinse

Acid Dip (10% H_2SO_4 — 1% $Na_2Cr_2O_7$)

Cold Rinse

Hot Rinse

Air Dry

In general, if the bath goes out of control, a progressive "off color" or "unfinished" appearance will result and is easily observed on the parts.

As the iron content of the bath increases, it is normally desirable to increase the temperature of operation and to lower the current density.

The rate of working the bath is a factor in control, but we have not been able to define it exactly as yet. We do know that lower amps/gallon has lowered the cost of operation, (that is, from operation at 20 amps/gallon down to 5 amps/gallon). This could possibly be due to metal interference, i.e. that the metals formed a very stable complex in the solution instead of precipating, and thus interferred with the electropolishing action. Ferric iron is more soluble than ferrous iron, so that if conditions do not favor reduction of iron, the ratio of ferric to ferrous increases, causing trouble or "off luster." Normally, ferric iron is reduced at the

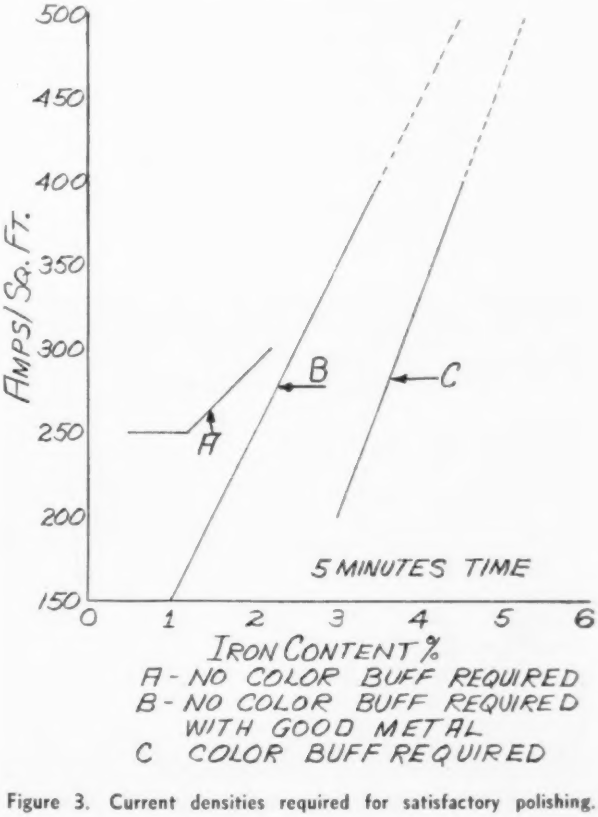


Figure 3. Current densities required for satisfactory polishing.

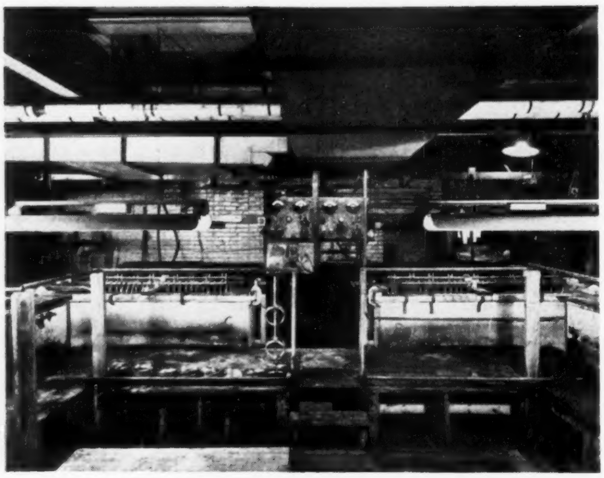


Figure 4. View of the 700 gallon units for electroplating at Electric Auto-Lite Co.

cathode, however, any crustation on the cathode will prevent the effective reduction of the ferric iron.

Steel tanks lined with chemical lead and then lined with acid proof brick or tile are recommended for permanent installations. With the high currents used, it is felt that the electrical insulation provided by the brick is essential.

An automatic temperature controlling system should be used, capable of heating or cooling, similar to that used on chrome tanks. Coils or heat exchangers in the tank or external heat exchangers can be used. If internal exchangers are used, the units should be made cathodic with a No. 14 wire to be sure they do not become anodic and dissolve.

Tank capacity is an item which may be overlooked, since the current density employed is so high. In general, the solution should operate at less than 5 amps per gallon. This necessitates having enough space available for cathodes to operate at 20% of the anode current density. Also, cooling problems are encountered when operating at a higher current rate per gallon.

Fairly rapid (50-80 ft./min.) mechanical agitation in a horizontal direction is usually necessary for preventing gas streaks. Parts having simple surface contour and wire goods can frequently be electropolished

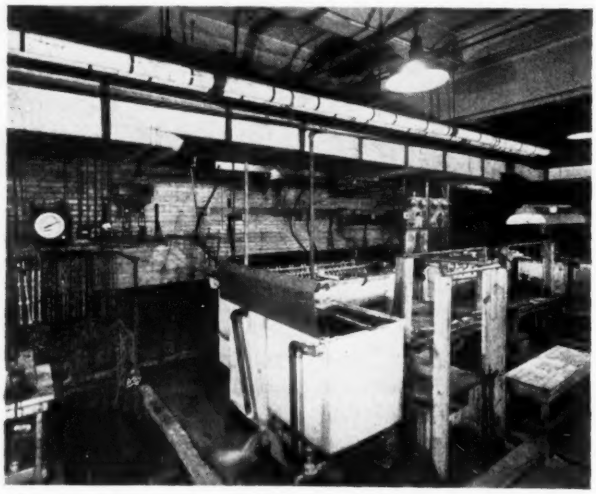


Figure 5. Another view of the production electropolishing set-up.

still, with advantage to appearance. Air agitation can be used but is only recommended for mixing and cooling the solution. Care should be taken to place air outlets so that sludge at the bottom of the tank is not disturbed. If possible, any flat surfaces on the work should be at an angle to the direction of agitation.

Our operation indicates that, with all other factors held constant, the single item which has the most effect is the iron content of the bath. That is therefore held within predetermined limits. The control on the variation of iron content is based upon amp/hour readings made daily. It can also be done from production records, since the area of each type of steel can be estimated and the iron content calculated. The iron

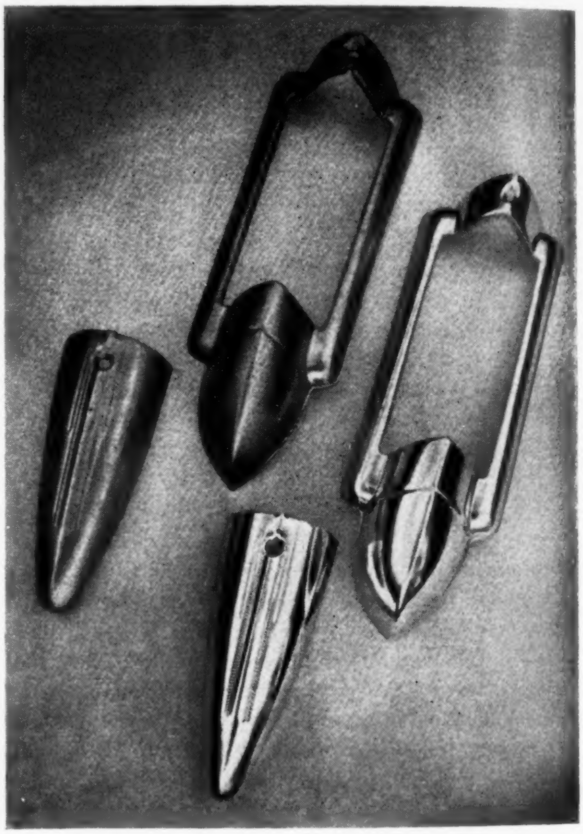


Figure 6. Parts on the left are before electropolishing; on the right after treatment.

content is held within specified limits by decanting old solution and adding new. To check possible mistakes in decant additions, leaks in coils, etc., daily checks are made on the specific gavity and total acid content of the bath. To insure proper operation, weekly analyses are made for iron, sulfate, and phosphate. At this time the ratio (SO_4 to PO_4) can be modified if necessary. Also, any variation in calculated iron increase can be adjusted.

Initially, lead cathodes were used in the bath and had the disadvantage that a large amount of sludge accumulated on them. The sludge has to be removed, since it causes an increase in voltage required to overcome the insulation effect. Tests were made using stainless steel cathodes. Type 316 stainless steel has proved to be more practical than lead because: (1) the cost of

(*Concluded on page* 112)

The entry end of the Zincgrip line. From right to left are shown the double uncoiler, two sets of pinch rolls, shear, welder, and loop car.

Continuous Galvanizing by the Sendzimir Process

By K. Oganowski, *Associate Director, Research Laboratories, Armco Steel Corp., Middletown, O.*

THE value of the zinc coating in combatting corrosion of iron and steel surfaces was recognized early and led to the development of the ever-expanding galvanizing industry.

The methods of application of zinc to the iron and steel surfaces have changed, and a gradual mechanization of the equipment has taken place. However, until 1936 the basic steps of the galvanizing procedure had remained unchanged. These consisted of cleaning of the surface of the material to be coated by pickling, fluxing the surface to promote wetting by molten zinc, and preheating the material in the molten zinc bath to a coating temperature.

With the use of cold-rolled steel as a base metal for galvanized sheets, removal of rolling lubricants by alkali cleaning and annealing of the metal before coating were added to the galvanizing process.

It has long been recognized by galvanizers that surface preparation of the base metal, temperature control during the coating operation, and composition of the spelter bath are the major factors affecting the manufacture of galvanized products. When all of these factors are simultaneously controlled at the optimum of their range of variation, a coated product of very high quality can be produced consistently.

Despite numerous improvements in cleaning, pickling, fluxing and heating of the zinc kettles for many years there was no major development toward simplification of these basically complex operations or maintaining the consistency of these operations.

Continuous coating lines utilizing the advantages of strip steel eliminate handling between some of the processing steps. They combine chemical surface preparation of the previously heat treated and temper rolled material with fluxing and coating in one continuous succession of individual treatments.

It must be realized, however, that metal treated by a continuous chemical process such as pickling or fluxing is subject to a continuously changing set of conditions. The composition of the solution, the rate of reaction, products of the reaction and the residual deposits on the surface change with every foot of the passing strip. The hazard of inconsistency is increased as more wet chemical treatments are added. It becomes necessary to use additives such as inhibiting, wetting, frothing, and sequestering reagents.

All basic correcting and modifying treatments present such complicated operation that, even under the best working conditions, the product quality of the conventional sheet galvanizing shop, especially coating adherence and ductility, leaves much to be desired.

In 1936, however, the first continuous zinc coating unit incorporating basic improvements and unusual new features was installed at Butler, Pa., by *Armco Steel Corp.* This initial unit, based on the Sendzimir coating process, stimulated development in continuous

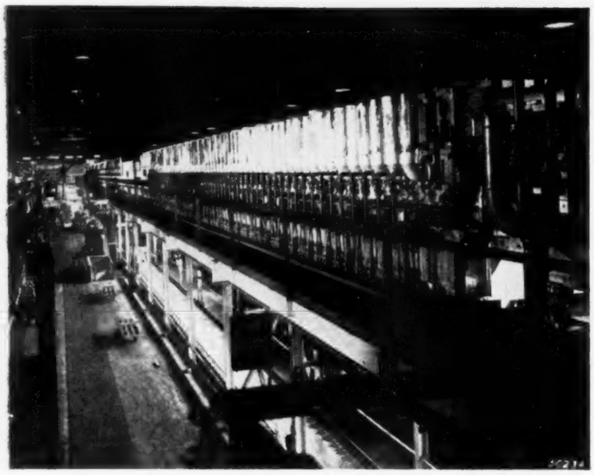


Figure 1. Reducing and cooling furnaces of the Zincgrip line. Beneath the furnace balcony in the foreground is the entry end loop car.

zinc coating which has revolutionized much of the galvanizing industry.

Sendzimir Coating Process

The Sendzimir coating process* embraces a radical departure from the conventional sheet galvanizing practice. It specifies a set of conditions under which the principal requirements of the coating operation — surface preparation, temperature control, spelter composition — are readily met and consistently controlled.

Surface Preparation

Surface preparation of the base metal, which is the first of the three basic requirements of the coating operations, is accomplished in two steps: (1) oxidation of the surface, and (2) subsequent reduction of this oxidized surface. The surface can be oxidized either by heating in an oxidizing medium or by other chemical means.

When oxidation by heat is used, it is possible to remove rolling lubricants and other combustible material. At the same time it provides a surface having the same degree of oxidation regardless of variations in the cleanliness of the surface of the metal upon its arrival at the coating unit. Such uniform surface preparation is possible because the products of the reaction which removes the surface contamination during the heating operation are gaseous, and the degree of oxidation obtained is controlled by only one readily controllable factor — temperature.

An alternative means of oxidation employs chemical methods. An alkaline cleaner removes rolling oils and is followed by rinsing and drying to secure oxidation of the surface.

In the reduction of the oxidized surface, the reaction products are gaseous and the quality of the reducing operation is controlled by composition of the atmosphere and the temperature in the furnace. Stable operation and reproducible results are obtained consistently in the reduction operation. This is because variations in the condition of the metal surface were eliminated in the previous oxidizing step. A certain degree of desulphurization and decarburization of the surface also occurs during the reducing operation.

*U. S. Patents 2,110,893 — 2,136,957 — 2,197,622

After the two steps described, the surface of the base metal is fully prepared for the molten zinc bath.

Temperature Control

Economy dictates the combining of surface preparation steps with heat treatment of the base metal. Therefore, the full-hard, cold-reduced material generally used in the Sendzimir coating process is annealed at the same time the oxidized surface is being reduced. Any heating and cooling cycle, practicable for a continuous annealing operation, can be employed in this process. However the metal when immersed in the zinc bath must be at a temperature which will allow instantaneous wetting and bonding with the zinc.

Control of the base metal temperature at the time of immersion in the bath fulfills the second requirement of a successful coating operation.

Controlling the temperature of the metal during oxidation, reduction, annealing and cooling is not difficult with properly engineered, modern, industrial equipment.

Maintaining proper atmospheric conditions throughout the furnace for reduction of the oxidized surface and prevention of reoxidation in the cooling section, is also not difficult. Practically it requires only maintenance of the quality and flow of a suitable reducing gas.

Bath Composition

When the metal surface has been properly prepared and the metal temperature is correct, wetting and bonding with zinc occurs instantaneously and a rapid reaction between the zinc and the base metal takes place. This reaction, unless suppressed, would result in the formation of brittle iron-zinc compounds in the coat-

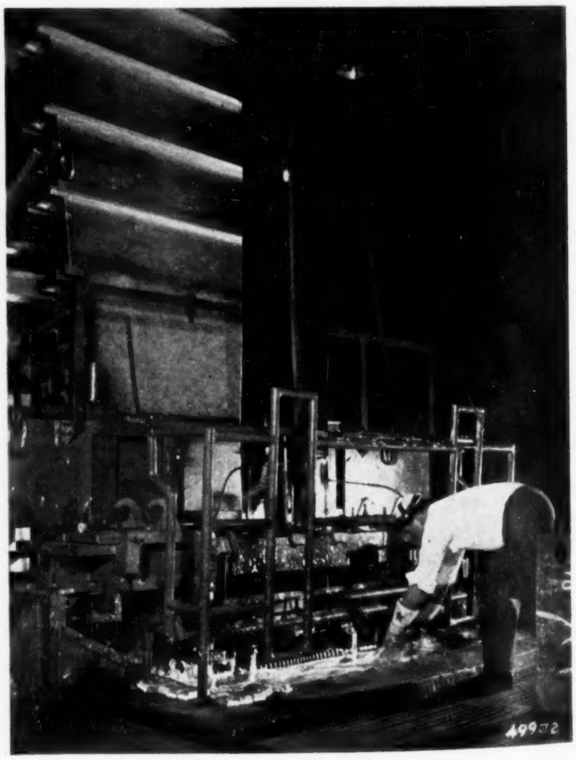


Figure 2. Adding zinc to the zinc pot. The structure at the left is the exit end of the cooling furnace.

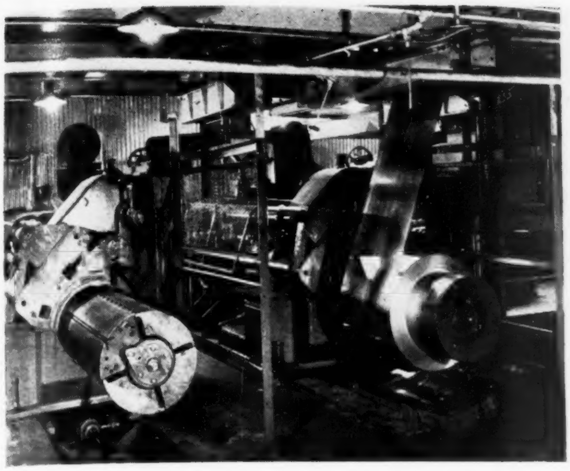


Figure 3. Receiving end of the line showing the double coiler unit.

ing. They would occur even with the shortest practicable immersion times, and the presence of these alloys would be detrimental to the ductility of the coating.

The rate of formation of iron-zinc alloys in the coating is controlled by the addition of aluminum to the zinc bath and by the temperature of the material being coated. The aluminum content of the bath can be readily controlled because, with the method of surface preparation used, no flux is necessary. In ordinary galvanizing processes, the desired amount of aluminum cannot be retained in the zinc bath due to the rapid reaction of aluminum with the flux.

Consequently, the third major requirement of the coating operation, suitable bath composition, is fulfilled and a ductile, adherent coating is obtained.

LIMITATIONS OF THE PROCESS

The limitations of this process are obvious. Because of handling problems it is not readily acceptable for coating cut-length sheets and formed articles. Neither is it very satisfactory for coating highly alloyed materials containing large amounts of elements such as chromium which have oxides that are difficult to reduce. Severely scaled steel or surfaces carrying compounds that are not combustible or volatile at oxidizing temperatures, such as some of the wire drawing lubricants, cannot be coated without additional pretreatments.

Equipment

The main features of the Sendzimir coating process consist of heating and cooling of the base metal, maintaining certain prescribed atmospheres at designated points, and immersing in the alloyed zinc bath at a suitable temperature. Such processing steps can be easily balanced and controlled with a high degree of precision under continuous operating conditions. Therefore, all components of the coating equipment must be so selected and arranged that a continuous flow of material through the unit can be maintained consistently.

If the equipment permits sustained operations at a scheduled rate of speed without stops or slow-downs, an amazingly uniform product quality can be obtained.

FEEDING END

Equipment on the feeding end (see photo at start of this article) must uncoil incoming strip and feed it into the coating line at a designated constant speed under specified tension. It also must allow for joining of the coils without affecting the speed of the unit.

Generally, this equipment consists of one or two payoff reels, auxiliary pinch rolls which manipulate the ends of the two coils during the joining operation, a shear, a welding unit, a looper, a tension device, and main feeding pinch rolls.

The looping device must be of a sufficient capacity to permit all steps of the coil joining operation to be performed when the unit is operating at its greatest speed. The tension device must regulate the tension of the strip in the furnace according to variation in thickness and width of the strip. The tension must be sufficient to guide the strip through the various components of the complete coating unit but not so great as to stretch or break the strip in the furnace.

FURNACES

The preheating furnace must preheat the strip uniformly to a designated temperature. The furnace capacity must be sufficient to heat the widest strip to be coated. It is desirable to equip the furnace with an adjustable firing pattern so that uniform oxidation over the width of the strip can be obtained for all widths.

A wide variety of industrial furnaces of a suitable construction are satisfactory. The choice of heat source depends on economical considerations. High temperature, direct-firing gas burners have been found to be well suited for this furnace, because they give maximum energy release per unit hearth area.

The annealing furnace (Fig. 1), placed in line with the preheating furnace, must complete heating the strip under a reducing atmosphere to the annealing temperature. The heating capacity of this furnace should be sufficient to attain the maximum specified temperature at the maximum rate of production.

The need for closely controlled atmosphere composition makes necessary specially designed furnace elements such as the entry door, shell, brick work, and hearth conveyor. Open flame burners should not be used in this furnace.

Gas fired radiant tubes or electric elements, driven hearth rolls of a suitable alloy and with properly sealed

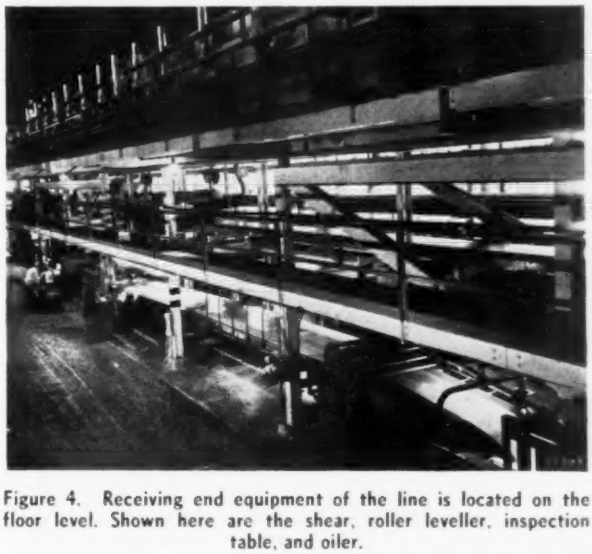


Figure 4. Receiving end equipment of the line is located on the floor level. Shown here are the shear, roller leveller, inspection table, and oiler.

bearings, and automatic controls are typical features of the annealing furnace.

The cooling furnace is directly connected to the annealing furnace and extends to the zinc bath with its end sealed by molten zinc. The purpose of this furnace is to control the rate of cooling of the strip, in a non-oxidizing atmosphere, according to the requirements of any particular annealing cycle or cycles for which the coating line is designed.

Since the rate of production is variable with the width of the strip, the quantity of heat to be dissipated is also variable. The cooling furnace must compensate for these differences so that the temperature of the strip on entering the zinc bath is essentially constant regardless of the width of strip. Consequently, the cooling furnace is equipped with automatically controlled heating and cooling means.

Any air infiltration in the final section of the cooling furnace would reoxidize the strip and spoil its wetting characteristics. Therefore special precautions must be taken in the design and construction of this section to avoid this hazard. Complete elimination of hearth roll out-board bearings in the final part of the cooling furnace has been found to be mandatory.

The pot furnace, which surrounds the zinc bath, must supply heat for initial melting of the zinc and also heat for maintenance of a uniform zinc temperature during normal operating conditions.

An electrically heated pot furnace serves most satisfactorily in this application. Under operating conditions essentially all of the heat required for heating and melting of the zinc and for radiation losses is supplied by the incoming strip. Only a small amount of the heat necessary to balance the zinc bath temperature is derived from the pot furnace.

The inherent uniformity of heating and the low investment cost of an electric furnace compensate for the small increase in cost of heating by electricity as compared to gas.

Pot and Pot Equipment

As this process does not require heating the strip in the bath or any specified time of immersion for wetting and bonding, the size of the pot (Fig. II) can be very small. It must, however, contain strip-guiding and finishing equipment and also must have space for accumulation of dross. With adequate pots, drossing is necessary only every 10 to 12 weeks. The very slow rate of dross formation in this process allows the use of a zinc pot with a capacity of only 5 to 7 tons of zinc per average rated ton of hourly capacity.

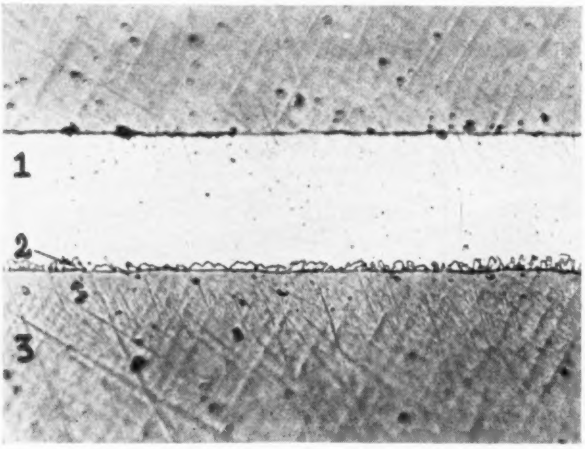


Figure 5. Microstructure of the Zincgrip coating. (1) Zinc coating. (2) Zinc-iron alloy. (3) Base metal.


Figure 6. A standard laboratory indentation test on regular galvanized steel causes the zinc coating to flake.

The amount of dross formed in a *given time* in this process, which does not require the use of flux and in which the temperature of the strip is closely controlled at the point of immersion, depends primarily on the length of travel through the zinc. The influence of speed or amount of metal moving through the pot is rather insignificant.

Two important relationships are derived from the proceeding facts: the amount of dross formed *per ton of coated product* is smaller if the travel through the zinc bath is shorter, and the amount of dross formed *per ton of coated product* for a given length of the travel is smaller if the amount of material passing through it is larger.

Since aluminum is present in the molten spelter and only low rate of heat transfer through the pot walls is required, ingot iron or fire box steel offers a greatly increased pot life in this service as compared with ordinary galvanizing operations.

A submerged idling roll is generally used for guiding the strip through the zinc bath. A suitable scraping device prevents excessive and non-uniform build-up of iron-zinc alloy on the surface of this roll, and, as a result, no redressing is required during the entire operating period between drossings.

Exit rolls, common to the sheet galvanizing operation, serve as a means of regulating the weight and uniformity of the coating. No flux is required on the surface of the bath to maintain a bright and uniform coating on the rolls. A mechanical scraping device is attached to the exit rolls to prevent deposition of oxide and dross on the surface of the coated strip. Service life of the exit rolls between redressings is 10 to 12 days.

Delivery End

The essential components of this equipment (Figs. III and IV) are typical of all continuous strip processing lines handling annealed steel strip. The delivery end of this type coating operation must provide: (1) sufficient time for the formation of the spangle; (2) rapid cooling of the coated strip so that no flexing or bending of the strip occurs at high temperatures; (3) absence of sharp or reverse bends in the pass line of the strip to avoid the hazard of coil breaks; and (4) sufficient looping devices to avoid interruptions in the constant coating speed.

The main set of pinch rolls, which establishes the coating speed of the line, pulls the strip through the furnaces and pot equipment. It is installed far enough from the pot to avoid damaging the coating or base metal. The speed of this set is changed with the changes in the gauge of the strip.

All other drives on the line are either synchronized with the main pinch rolls or separated from it by looping devices. This provides that all stops, slow-downs, and speed-ups required by the coil changing manipulation on the feeding and delivery ends can be performed without affecting the speed of the main pinch rolls.

Roller leveling, oiling, rejection separation, stenciling, coiling, and shearing equipment are generally incorporated in the unit. Consequently most of the coated material is ready to ship as it leaves the coating line.

Temper rolling, slitting, and Bonderizing, which can be carried out at constant high speeds regardless of the thickness of the strip, are generally separate operations.

AUXILIARY EQUIPMENT

Dissociated anhydrous ammonia (75% Hydrogen - 25% Nitrogen by volume) serves as a satisfactory reducing atmosphere in the annealing furnace and as a non-oxidizing atmosphere in the cooling furnace.

A liquid ammonia storage tank with a holding capacity of one to two carloads and an ammonia dissociator with a capacity of 1,000 to 2,000 cubic feet of dissociated gas per hour are adequate to supply the atmosphere needs. The required capacity of the ammonia dissociator depends largely on the width of the unit and the method of sealing the entry to the reducing furnace.

Operation

Safety of the personnel, quality of the product, and a high rate of production depend on maintaining uniform continuity of the operation.

Continuity of the operation, as has been stressed, depends upon proper equipment but it also imposes definite requirements on operating personnel. Regardless of how good and how complete the equipment is, it cannot be operated with greatest efficiency unless every operator is properly trained. He must perform his assigned duties in a competent manner both as an individual and as a member of an operating team. And the team includes not only men of the operating crew but also maintenance men and men in charge of metallurgical quality control.

Operators, maintenance men, and metallurgists must be familiar with the principles of the processing and

Figure 7. The same test which caused flaking of ordinary galvanized has no effect on the Zincgrip coating. The zinc adheres to the base metal despite severe stretching.

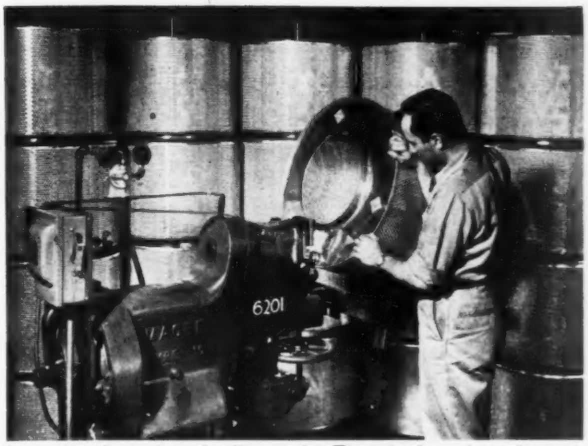


Figure 8. Expanding the flange of a Zincgrip drum for a domestic automatic laundry drier.

with their mutual duties before interdepartmental cooperation can be developed and every individual can contribute fully to the most efficient overall operation.

It is not practical to start this type of process slowly or operate at reduced speed while the operators are acquiring the necessary training and the equipment is being synchronized. Proper rates of heating and cooling and the desired balance of temperatures throughout the processing equipment cannot be obtained at reduced speeds and inferior quality product is produced.

A better procedure is to synchronize the equipment and familiarize the men with their functions while running the equipment without heat in the furnaces or molten zinc in the pot.

After training the crew and adjusting the equipment, zinc is melted in the pot, the furnaces are preheated and the atmosphere is introduced in the cooling and reducing furnaces. Then the unit is threaded, temperature settings adjusted, and operations started at full rated speed. The same procedure is employed after drossing or complete shutdowns.

The line speed is changed according to the thickness of the strip so that a constant weight per hour is produced for a given width.

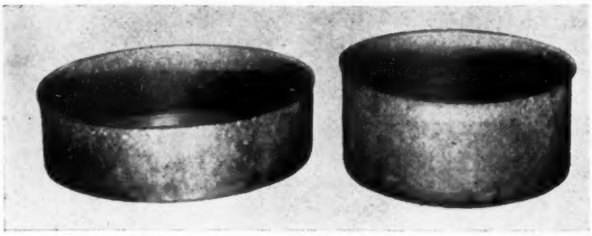
Tension of the strip between the feeding and the main pinch rolls is adjusted for variations in the width and thickness of the strip.

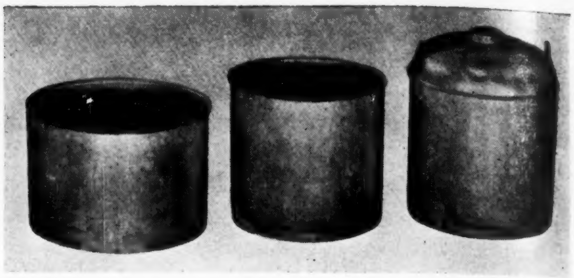
Operation of the oxidizing furnace is controlled to produce strip temperature at the exit end of the furnace in the range of 750 to 850°F. The firing pattern of the furnace is adjusted for strip widths to insure uniformity of surface oxidation across the width of the material.

The temperature in the reducing furnace is controlled automatically and set according to the heating cycle. The rate of temperature decrease in the cooling furnace is also maintained automatically by temperature controls for individual zones in the furnace. The cooling or heating media are engaged automatically enabling the strip to arrive at the pot at the desired temperature range of 900 to 950°F.

Either normalizing or sub-critical annealing cycles can be used in the process. Somewhat better and more uniform physical properties of the base metal can be obtained when a normalizing cycle is used.

The temperature of the zinc bath is maintained in the





Figures 9-10. Consecutive draws in the fabrication of a gasoline can. Despite severe drawing, the Zincgrip coating does not flake or peel.

range of 850 to 860°F. It is essential that fluctuation of the zinc temperature be avoided. Increased temperature causes greater solution of iron in the zinc; then when the bath temperature lowers the iron comes out as a fine dross in the coating.

The aluminum content of the bath is maintained by the addition of zinc-aluminum alloy (10% Al.) in the amount of about two pounds of aluminum per 1000 pounds of added zinc.

Coating weight is regulated by adjusting the position of the center-line of the exit rolls with respect to the level of the molten zinc in the bath, just as in conventional galvanizing. Cleanliness of the coating is secured by using scraping blades on the exit rolls.

After 10 to 12 weeks of continuous operation, the coating line is usually shut down for a drossing operation. The procedure for shutting down is the reverse of that for starting up: strip is run out of the furnace; the temperature of the furnace is lowered; the reducing atmosphere is burned out; and the drossing operation is then performed.

Shutdown periods are also utilized for any maintenance work that cannot be performed while the line is in operation.

The Coated Product - Zincgrip

The commercial zinc coated product, manufactured by Armco Steel Corp. using the Sendzimir Coating Process, is well known as Armco "*Zincgrip*." It was first introduced on the market in 1936.

The recognized properties of this material are: (1) tenacious adherence of the zinc coating, (2) attractive lustrous appearance, and (3) excellent forming properties of the coating as well as base metal.

It is produced in cut length sheets and coils in thicknesses from .018 to .115 inch and in widths up to and including 48 inches. It can be produced in any specified weight of coating up to 2.50 oz./sq. ft.

A phosphated surface is supplied when paintability and improved paint adherence are required. Material so treated is known as Armco *Zincgrip Paintgrip*.

The average mechanical properties of the base metal are listed in Table I.

Table I

	Base Metal Yield Strength Lbs./Sq. In.	Tensile Strength Lbs./Sq. In.	% Elongation in 2 Inches	Rockwell Hardness B-Scale
Ingot Iron	35,000-45,000	50,000-59,000	20-27	55-70
Copper Steel	40,000-45,000	52,000-57,000	23-30	58-68
Mild Steel	37,000-45,000	52,000-57,000	25-30	58-65

The reason for the unusual properties of the coating can be found in its metallographic structure (Fig. V). The complete elimination of the most brittle iron-zinc alloys and the restricted formation of the other less brittle iron-zinc alloys results in excellent adherence and ductility of the coating. No separation of the coating from the base metal occurs even under severe forming, spinning, and deep drawing operations. (Figs. VI, VII, VIII, IX.)

Annealing and coating in a continuous manner results in a remarkable product uniformity, especially in mechanical properties of the base metal and in weight, distribution, adherence, and ductility of the zinc coating.

The outstanding coating adherence and workability of the zinc coated product manufactured by the Sendzimir coating process has led to a much broader application of galvanized sheets and coils. It can be used for many products which formerly had to be hot dipped after fabrication. Ordinary galvanized sheets could not be used because the coating flaked and peeled as a result of forming and drawing operations.

Adherence of the coating produced by the Sendzimir coating process is sufficient to withstand drawing and forming operations to the limit of the drawing ability of the base metal without peeling.

The proof lies in the performance. Armco *Zincgrip* has been used successfully for thirteen years. It has given metal fabricators a zinc-coated sheet steel that can be severely formed and drawn without loss of coating, and enabled them to offer complete rust protection to users of their products.

Quality of product, economy of operation, and healthful working conditions in the shop — all have led to the rapidly increasing use of this process to the galvanized of iron nad steel sheets.

Sprayed Metal Coatings for Corrosion Protection

By G. Tolley, M.Sc., A.R.I.C.

Mr. Tolley was formerly chief chemist at Metallization Ltd., Dudley, England. At present he is on a leave of absence to carry out chemical research at Princeton University.

As an engineering process metallizing is well-known, but the full value of sprayed metal coatings in the field of corrosion protection is not generally realized. It is surprising, for example, to find no mention of sprayed aluminum coatings and only a slight reference to the use of sprayed zinc coatings in the recent authoritative *"Corrosion Handbook"* edited by *H. H. Uhlig.*[1] This omission from a standard work on the subject of corrosion is serious when one recalls the importance of metallizing in the corrosion field in Europe, and particularly in Britain.

The fact that there has been much less emphasis in the U.S.A. upon the corrosion-resistant properties of metallized coatings is not difficult to explain. Primarily, the metallizing gun has been developed here as a tool for application mainly in the engineering industries. Such guns have been designed to achieve high rates of application, with the result that coatings of such metals as aluminum and zinc, when sprayed with these guns, have not always the ideal properties for corrosion protection. In England, on the other hand, designers of the wire-fed gun have concentrated upon producing a general purpose tool which will yield coatings having good corrosion resistance as well as being of value in "building-up" operations.

Those who are particularly interested in the different designs of metallizing guns, and the properties of deposits produced from each, will find a detailed description of the various types in the recent book by *Ballard.*[2] As this book deals adequately with these points it is not necessary to repeat it here. However, there has been work carried out in England during the past few years which has established the quantitative aspects of the corrosion resistance of sprayed metal coatings, and a discussion of this work should be of value in focusing attention on the use of metallizing in this sphere.

The very comprehensive work of *Hudson* and *Banfield*[3] on the corrosion resistance of metal coatings on steel gives detailed results and effective comparison of sprayed coatings with metal coatings produced by other means. They exposed test panels at the following sites:

- Calshot — marine atmosphere with slight atmospheric pollution.
- Llanwrtyd Wells — heavy fainfall and salt from sea. No atmospheric pollution.
- Sheffield — highly industrialized atmosphere.
- Congella (S. Africa) — marine atmosphere.
- Apapa (Nigeria) — tropical marine atmosphere.
- Singapore — tropical marine atmosphere.

Zinc Coatings

The earlier results of the A.S.T.M. were confirmed in this work, and it was found that the coating weight determined the corrosion resistance, irrespective of the method of application. This is important, as it shows that sprayed zinc coatings are at least comparable with other methods of application, and in view of the wide scope of metallizing and the ease of control of thickness, sprayed coatings have an advantage over hot dipping, electroplating and cementation for many applications. The relation between the life of the coating and its weight can be seen from the equation:

$$L_o = 2.6w + 0.5$$

where L_o = life of coating in years (5% rusting was taken as the point of failure in the above series of tests).

and w = weight of coating in oz./sq. ft.

On this basis, a sprayed zinc coating of 1.7 oz./sq. ft., i.e. 2.9 mils, would have a life of five years (to the point of 5% rusting) in the highly polluted atmosphere of Sheffield. The results in non-industrial atmospheres are generally better than in the polluted atmosphere of Sheffield.

Immersion tests in the sea at Gosport and Caernavon have shown that sprayed zinc coatings are still virtually unaffected after two years immersion. There is some evidence that coatings applied by the wire pistol are better than the other coatings. The anti-fouling properties of zinc are, of course, of considerable importance in marine immersion. The results obtained by *Hudson* and *Banfield* are supported by earlier work,[4] when it was shown that immersion of zinc-sprayed steel in the sea at Singapore had no effect on the coating after seven months immersion, and the absence of barnacle growths was particularly noticeable. These results are in general accord with years of practical experience, during which zinc coatings have been applied to piers and jetties, fixtures adjacent to the sea, and boats' hulls and fittings.

All photos used through the courtesy of the Steel Co. of Wales, W. S. Atkins & Partners (Consultants), and Metallization Ltd.

The above equation refers of course, to an untreated metal coating, and the life of such a coating can be considerably increased by painting. A good procedure is to use a very thin coating of zinc as a base for paint, followed usually by a zinc chromate primer and the necessary finishing coats. Such a method offers an excellent scheme of protection for many jobs. The surface of sprayed metal, because of its slight porosity, offers an excellent bond for paint, and such a method of surface preparation has been found to be of very great use. Not only does the whole system form a very effective means of corrosion protection, but the finishing paint is found to preserve its color and finish for a much longer period when compared to the usual passivation methods of pre-treatment. The fact that a sprayed zinc coating offers an ideal base for paint can be shown by attempting to improve paint performance by passivating the sprayed zinc surface. Methods of chromating and phosphating offer little real improvement in the performance of the paint, so that it may be concluded that a sprayed zinc coating gives a natural key which cannot be radically improved by passivation. Any question of pre-treatment of sprayed coatings before painting is therefore superfluous, as the matte, slightly porous surface of a sprayed deposit is naturally ideal for taking paint. The choice of primer is important, and a good inhibitive paint such as zinc chromate, often mixed with zinc oxide, is found to give excellent results. The thickness of metallized coating necessary is not critical, and a mere flash coating will be adequate to provide an excellent surface.

However, it should be pointed out that once the paint film has failed the zinc will be corroded away at the usual rate, and therefore a thicker sprayed metal coating is very often advisable, particularly on jobs that cannot always be easily repainted.

Sprayed zinc coatings have been extensively used both bare and painted on steel frame buildings, ships' hulls, pylons, hydro-electric power schemes, steel window frames, gas holders, and countless types of smaller jobs. In many cases it would be impossible to apply a metal coating by any other means because of the size or complexity of the article. In metallizing however, there is no limit to the extent of surface covered, and in addition, as the process is cold, there is no distortion.

Figure 1. All constructional work above the crane level on this building at the Steel Co. of Wales has been sprayed with .003" aluminum. It is expected that repairing on this structural work will not be required for 20 years.

Cadmium Coatings

It is well to mention sprayed cadmium coatings, for often a comparison between zinc and cadmium is desired. The corrosion resistance of cadmium coatings depends only on the weight of metal applied, and is independent of the means of application. In this respect cadmium resembles zinc. In an industrial atmosphere such as Sheffield cadmium coatings are very much inferior to zinc, and the relation between the life of the coating and its weight, for this type of exposure, may be expressed as:

$$L_o = 1.1w + 0.1,$$

using the same notation as for zinc coatings.

On this basis, in order to obtain a coating life of five years in Sheffield (i.e. to the point of 5% rusting) a weight of 4.5 oz./sq. ft of cadmium would be required, having a thickness of 6.0 mils, as against 1.7 oz./sq. ft. and 2.9 mils of zinc.

The performance of cadmium is much better in marine atmospheres than in industrial localities, thus supporting results of early salt spray tests. However, in view of the cost of cadmium the improved protection obtained by its use is not economical when matched against that provided by zinc or aluminum. From the point of view of metallizing there are very few jobs for which zinc could not be substituted for cadmium without detriment to the protective qualities of the coating. It is only in marine atmospheres where there is likely to be any question of preference for cadmium, and in these cases economic aspects will usually force the choice for zinc.

Tests carried out with zinc-cadmium alloys have not indicated any improvement over the results obtained with zinc or cadmium singly, and so it seems that the spectacular results obtained by the use of tin-zinc alloys cannot be imitated in the zinc-cadmium field.

Aluminum Coatings

The most satisfactory way of applying an aluminum coating is by spraying, for both hot dipping and cementation suffer from disadvantages which restrict the size of the articles and necessitate careful working to avoid distortion. As a protective coating aluminum has received a good deal of attention in recent years, and the prevailing tendency (in Britain) is to substitute more and more aluminum for zinc coatings. As a metal it possesses high corrosion resistance to all types of atmosphere, and this property is preserved in sprayed coatings. Aluminum coatings tend to be slightly less ductile than coatings of zinc, and the electrochemical relationships with steel tend to be complex, but these are not real disadvantages, and the use of aluminum for protective purposes on steel is undoubtedly a development that holds a great future.

Experimental investigation of the corrosion resistance of aluminum coatings was commenced in 1931 by *Britton* and *Evans*[5] and the results obtained by these workers have been confirmed by subsequent work. The results of *Hudson* and *Banfield*, embodying observations on various methods of applying aluminum coatings, show that the only really satisfactory means of application is that of spraying with the wire or molten-metal gun. Hot-dipped, cemented, or powder sprayed aluminum coatings fail much more rapidly, although it should be pointed out that the hot-dipped

and cemented coatings are intended mainly for heat resistance. There is some question of powder-sprayed coatings showing adverse performance owing to the presence of copper in the aluminum, and work is now under way to decide upon this question. It is the opinion of the author that powder-sprayed coatings in general do not provide as good corrosion resistance as those coatings from the wire or molten metal gun because of excessive oxidation and porosity caused by the particular design and operation of the powder pistol.

Hot-dipped and cemented aluminum cotings give erratic results in exposures to various types of atmosphere: generally speaking, wire-sprayed coatings of the same thickness have a life at least two to three times as long. In addition, a sprayed aluminum coating provides an excellent surface for painting, and a protective scheme composed of such a combination may be expected to have a very long life.

Under conditions of marine exposure and marine immersion aluminum coatings possess excellent resistant properties, and there is increasing evidence that they perform better than zinc coatings of the same thickness. Aluminum, unlike zinc, possesses no antifouling properties, but this is hardly a factor of importance as in most cases a painting scheme will be applied on the aluminum coating.

In an industrial atmosphere steel that is coated with sprayed aluminum and left unpainted will behave in accordance with the equation:

$$L_o = 5.1w + 0.9,$$

where the notation is as before. In an atmosphere such as Sheffield then, the surface will be 5% rusted after approximately five years if a minimum thickness of 3.6 mils is applied, i.e. 0.8 oz./sq. ft. This coating weight compares very favorably with zinc, and there is little doubt that application of sprayed aluminum provides one of the most notable advances in recent years in the field of corrosion protection.

In addition, the development in England of a thoroughly automatic process of metallizing large structures has focused attention on the wide scope of this method. It is now feasible to metallize on an economic basis the steel used in building a very large factory, such as that of the Steel Company of Wales in South Wales. In this latter project, steel work is coated with .004" aluminum followed by a painting scheme, and it is not proposed to re-paint for 20 years. In this way a very considerable saving on maintenance and depreciation will be effected. The automatic process used for coating 51 ft. x 16 in. steel sections consists in passing them through a shot-blast machine and then through a spraying unit consisting of 26 guns mounted so as to cover the surface of the article completely as it is conveyed along at the speed of 10½ ft. per minute. The position of the pistols on the spraying unit can be altered so as to allow of considerable flexibility in the shape of section treated. At the moment all this type of work is being done with aluminum coatings.

It was mentioned above that the electrochemical relationships of aluminum and steel tend to be complex and variable, and some discussion of this question should be of interest. In British metal spraying practice it is rare to apply a coating of aluminum of thickness greater than .006", and the more common thickness

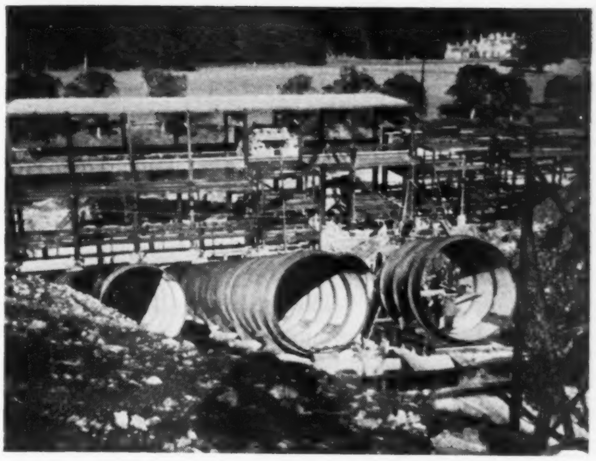


Figure 2. These 20 ft. diameter pipes for carrying water at a Scotch hydroelectric plant are shown being sprayed with metal for preventing corrosion.

is .004", or .003" when painting is to follow. For an unpainted coating of .004" thickness on steel it has been conclusively shown that excellent corrosion resistant is obtained over a period of at least 5 years in the most highly polluted atmosphere. However, in spite of the excellent corrosion resistance of such aluminum coatings there is one apparent disadvantage which has been observed to occur. This is the appearance of rust stains on the coating during a very early stage of exposure, often within a day or so. Such rust staining is of course, not good from the consumer's point of view, and because of its spasmodic and unpredictable appearance on coatings which were shown to be sound it detracted considerably from the use of aluminum coatings. A thorough investigation of this occurrence has been recently carried through by the present author,[6] who has shown that the electrochemical relationships of aluminum and steel are very variable in the early stages of exposure. Contrary to usual statements, aluminum is cathodic to steel in most liquid media, with the exception of acid solutions of pH less than 3 and solutions containing a certain minimum concentration of aluminum ions. Study of potential-time curves and observation of aluminum coatings on steel shows that in many cases there is a reversal of potential, so that the aluminum which is initially cathodic becomes anodic and therefore is able to provide sacrificial protection if the current density is sufficient. It was shown that rust staining is caused by initial corrosion of the iron due to liquid seeping through the porous coating, a process which ceases quite rapidly as the potential reverses. This reversal of potential is conditioned by several factors which are detailed and discussed in the original paper.

There are three ways of preventing such rust staining.

(a) By applying a coating thickness greater than .006", which will prevent access of liquids to the underlying steel. Such a procedure would be wasteful, for there is no evidence whatsoever that initial rust staining is detrimental to the protective properties of the coating.

(b) By avoiding contact with the atmosphere for several days after spraying. If this procedure is adopted, and an atmosphere likely to cause rust staining is avoided, the very slight attack

on aluminum by a normal atmosphere causes changes which are sufficient to ensure that aluminum becomes anodic to the steel. Such a method would be impracticable.

(c) By washing the surface of the sprayed article with solutions that cause aluminum to become anodic, either by their effect on electrochemical equilibrium, or by corrosion of the aluminum causing break up of the oxide film. Such solutions have been used successfully in practice and include M/500 sulphuric acid (i.e. 0.01%), and 0.05% aluminum sulphate solution. These treatments have been found to reduce considerably the tendency to rust staining, and they are easy to introduce as a routine process for all sprayed aluminum coatings.

Aluminum Coatings for Heat Resistance

The use of cemented and hot-dipped aluminum coatings for heat resistance is well known, and in metallizing a similar result can be achieved by spraying an aluminum coating and then heat treating at 850-900°C. to obtain a diffusion layer which will provide excellent heat resistance. Such a method has several advantages over the two former processes, for the size of article is conditioned only by the size of the available heat treating furnace, and the process can be accurately controlled so as to yield a standard thickness of diffusion layer.

It is now generally realized that aluminum coatings alone, without subsequent heat treatment, provide excellent resistance against moderate temperatures up to 550°C. Under temperature conditions when pure aluminum would be tending to soften and peel, sprayed aluminum remains hard and protective owing to its peculiar structure of laminated oxide and metal. Such a coating is of value for protection against hot flue gases, for aluminum has a high resistance against sulphur compounds. The author has investigated the resistance of aluminum coatings to sulphur dioxide-air mixtures at various temperature,[7] and the expected resistance has been obtained in practice. It is of interest to note that at temperatures of the order of 400-700°C. the corrosion of steel by sulphur dioxide-air mixtures is caused mainly by a process of catalytic oxidation, with subsequent rapid attack by the sulphur trioxide so produced. Application of a sprayed coating of aluminum reduces the rate of catalysis very considerably and corrosion is thereby reduced also. The use of such coatings can be expected to have a useful field in boiler installations, ducting and furnace accessories.

Coatings of Other Metals

Attention has been concentrated here mainly upon zinc and aluminum because these are the most widely used and generally useful metals in corrosion protection. No attempt will be made to deal with the application of metallizing in the chemical industry, for each particular problem demands its own solution, and specific recommendations can rarely be made on the basis of general principles. However, the use of sprayed coatings of stainless steels, nickel and nickel alloys, and bronzes will very often provide a solution to some difficult problem of protection in the chemical industry, whether that problem is connected with storage or reaction vessels, or moving machinery. By skillful working it is possible to apply thick coatings of the order of 1/16" or more to suitable vessels, which may then be polished to yield a "clad' material which will in effect have the corrosion resistance of the coating metal. Such work is not easy, and if done in a shoddy manner is useless, but it can be carried out as a routine part of the service of the metallizing industry in the field of corrosion protection.

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LEAD-TIN ALLOY PLATING

(*Concluded from page 56*)

liter. The residue is ignited to constant weight (final heating over a blast lamp for 2 minutes).

Calculation: $$\frac{SnO_2 \times 0.7877 \times 100}{\text{Weight of sample}} = \% \text{ Tin.}$$

The filtrate is retained for lead determination by evaporating to about 10 ml. volume. Cool and add cautiously and slowly 10 ml. of strong sulfuric acid. Lead sulfate will precipitate. Heat to heavy sulfuric acid fumes. Cool and wash down the sides of the beaker with water from a wash bottle. Evaporate to sulfuric acid fumes again (this second evaporation is done to remove all traces of nitric acid which will dissolve lead causing low results).

Cool, dilute to 150 ml. with lead acid solution (prepared by diluting 150 ml. sulfuric acid with 900 ml. of water followed by 0.5 gm. of lead acetate dissolved in 150 ml. of water. Stir well and let stand for 24 hours, then filter), and bring to boil.

Cool, allow to stand 2 hours and filter through a tared Gooch crucible. Wash 6 times with the above lead acid solution. Heat gently over a low burner and then to constant weight at very dull redness (500-600°C.) by suspending the crucible in a larger one so that an air space separates the crucibles. Cool in a desiccator and weigh.

Calculation: $$\frac{\text{Wt. } PbSO_4 \times .6833 \times 100}{\text{Wt. of sample}} = \% \text{ Lead}$$

Lead may be determined by a more rapid method with hydrobromic acid to remove the tin. Dissolve the sample by heating in 10 ml. of sulfuric acid in a 400 ml. beaker. Allow to cool, add 30 ml. of HBr (1:1) and with the cover glass partly raised, evaporate to dense white fumes. Cool and make a second addition of 1:1 HBr and evaporate to a volume of about 10 ml. To insure removal of all HBr, cool, wash down the sides of the beaker and evaporate to dense white fumes again. Cool, add 150 ml. lead acid solution and follow as given in paragraph above.

Conclusions

One of the most interesting characteristics of this process is the simplicity of controlling deposit composition. This makes it possible to deposit alloys from low tin-lead bearing metals to high tin-lead solder alloys with equal ease through minor charges of operating conditions.

Prosthetics Research Requires Unusual Rectifier Control

AFTER World War II the Army Medical Center became very active in one branch of prosthetics — the design and construction of artificial limbs. The *Army Prosthetics Research Laboratory*, sponsored by the office of the Surgeon General, is concerned with research leading to improved prosthetic devices and the development of materials and methods for manufacturing such devices. This article will indicate, briefly, how electrolytic metal finishing is one of the many techniques which enter into this important work.

The Army Prosthetics Research Laboratory is divided into two main branches: Mechanical Development and Plastics Development. The former designs and constructs experimental models of mechanical hands and hooks. The Plastics Branch is concerned with the utilization of commercially available materials, and the synthesis of new materials, to be used in prosthetic devices, for example plastic arms, legs, cosmetic gloves, etc. Among other processes, the Plastics Branch deals with electroforming, anodizing, slush molding and mold construction.

To supply D.C. for these processes an unusual rectifier unit was developed at the request of *Mr. Clare L. Milton, Jr.*, former chief, Plastics Development Branch of the Army Prosthetics Research Laboratory. The Laboratory, at Army Medical Center, Washington, D. C., is now using the rectifier unit, and the following notes are abstracted from information kindly supplied by *Dr. Fred Leonard*, present chief of the Plastics Development Branch.

Anodizing

The rectifier was ordered specifically for color anodizing and also for electroforming nickel molds used for producing plastic cosmetic gloves. Concerning the color anodizing use, it has been observed that when a plasticized polyvinyl glove is pulled over an aluminum mechanical hand shell, the plastic glove becomes grey in color and the hand looks dead. The purpose of color anodizing is to obviate this and to give a flesh-colored background for the glove. In addition, when bare aluminum muscle-tunnel pins are used for cineplastic amputees, it has been found that the skin turns black at this area. It is expected that anodizing the muscle tunnel pins will prevent this.

The rectifier unit has a maximum rating of 100 volts, which is about twice as high as that normally used for chromic acid anodizing and four to five times as high as that used in sulphuric acid (Alumilite) anodizing. In connection with this, Dr. Leonard says:

> "— at the time this equipment was ordered, reports were coming from Germany of anodizing in oxalic acid solutions and mixed electrolyte containing oxalic acid and/or oxalates. These baths are used at 65 volts and perhaps in some cases to 80 volts. In addition, the method of construction of the rectifier chosen lends itself to achievement of 100 volts D.C. without appreciable extra expense, and it was believed that the unit might serve as a source of D.C. for any miscellaneous purposes which might arise in the laboratory requiring 100 volts."

Nickel Plating

The cosmetic gloves, made of plasticized polyvinyl chloride, are unbelievably realistic. In addition to nails, skin ridges (i.e. fingerprints) palm lines — all carefully tinted, the gloves include the reproduction of slight skin imperfections, and scars. The gloves are formed in nickel molds which obviously must be held to extremely close tolerances. The constant current feature (automatic current stabilization) of the rectifier unit is useful in plating the molds. The irregular mold shape requires the use of cathode thiefs and

(*Concluded on page* 75)

Control unit for special rectifier programming control.

Electrochemical Society Meeting To Feature Electrodeposition

October 11-13 – Buffalo, N. Y.

THE 98th meeting of the Electrochemical Society, which will be held at the Statler Hotel, Buffalo, on October 11-12-13, will feature a 2-day technical program and symposia on electroplating. In addition, technical programs of the Corrosion Division, Battery Division, Electro-Organic Division, and Electrothermic Divisions will also be held.

Plant trips, luncheons, and dinners will round out the social and technical programs. A registration fee of $6.00 for members and $8.00 for non-members will be charged. Featured on the first day's program will be a symposium on Corrosion, with *Dr. I. A. Denison* presiding. Papers on bi-metallic corrosion, cathodic protection, and corrosion testing techniques will be presented. This symposium will be continued on Thursday morning. A complete program will be published in the *Journal of The Electrochemical Society* for October.

Of special interest to electroplaters will be the four sessions on Electrodeposition which will be given on Thursday and Friday, October 12-13. The following papers will be presented:

Dr. Charles L. Faust
President—Electrochemical Society

Thursday — Oct. 12

SYMPOSIUM ON PREPARATION OF THE CATHODE FOR PLATING

Dr. R. A. Schaefer, presiding

9:20 a.m.

Introductory remarks.

9:30 a.m.

Surface Preparation of Nickel Silver, Brass, and Copper for Electroplating, by *Daniel Gray*, Oneida, Ltd., Oneida, N. Y.

10:00 a.m.

Cleaning and Etching of Aluminum Alloys, by *Walter R. Meyer*, Enthone, Inc., New Haven, Conn.

10:30 a.m.

Diphase Metal Cleaning in Electroplating, by *Foster Dee Snell* and *Irving Reich*, Foster D. Snell, Inc., New York, N. Y.

11:00 a.m.

The Relative Reliability of Aluminum and Zinc Starting Sheets for the Electrodeposition of Zinc," by *Glen C. Ware* and *Kenneth B. Higbie*, Bureau of Mines, U. S. Department of the Interior, Albany, Ore.

11:30 a.m.

Zirconium and Titanium as Cathode Materials for the Electrodeposition of Zinc, by *Glen C. Ware* and *Kenneth B. Higbie*, Bureau of Mines, U. S. Department of the Interior, Albany, Ore.

Thursday — October 12

SYMPOSIUM ON EVALUATION OF A CLEAN CATHODE

Dr. R. A. Schaefer, presiding

2:00 p.m.

Water-Break Type Tests for the Evaluation of Metal Cleaning, by *S. Spring*, Pennsylvania Salt Manufacturing Co., Wyndmoor, Pa.

2:30 p.m.

The Detection and Estimation of Oils on Metal Surfaces With Ultraviolet Light Procedures, by *O. M. Morgan* and *L. F. Hoyt*, National Aniline Div., Allied Chemical & Dye Corp., New York, N. Y.

3:00 p.m.

Detection of Soil Removal in Metal Cleaning by the Radioactive Tracer Technique, by *J. C. Harris*, *R. E. Kamp*, and *W. H. Yanko*, Central Research Dept., Monsanto Chemical Co., Dayton, O.

Dr. Ralph Schaeffer
Chairman—Electrodeposition Division

3:30 p.m.

Soil Removal Testing and Cleanliness Evaluation, by *A. Mankowich*, Aberdeen Proving Ground, Md.

4:00 p.m.

The Ascyclic Generator for Electrolytic Processing, by *Gordon J. Berry*, The Electric Products Co., Cleveland, O.

Friday — October 13

SYMPOSIUM ON THE CATHODE OR ANODE DURING ELECTROLYTIC PROCESSES

Dr. R. A. Woofter, chairman

9:00 a.m.

The Cathode Polarization Potential During the Electrodeposition of Copper. I—The Apparent Instability of Acid Copper Sulfate Solutions and the Production of Solutions of Consistent Characteristics, by *L. L. Shreir* and *J. W. Smith*, Bedford College for Women (University of London), London, Eng.

9:20 A.M.

Theoretical Analysis of the Current Density Distribution in Galvanic Baths, by *Carl Wagner*, Department of Metallurgy, Massachusetts Institute of Technology, Cambridge, Mass.

9:45 a.m.

Plating Experiments with Aqueous Solutions at High Temperatures, by *Seymour Senderoff* and *Abner Brenner*, National Bureau of Standards, Washington, D. C.

10:10 a.m.

The Anode Layer in the Electrolytic Polishing of Copper, by *H. F. Walton*, University of Colorado, Boulder, Colo.

10:35 a.m.

Studies of Hydrogen Embrittlement in Cadmium Plated Steel, by *Robert Weast*, Case Institute of Technology, Cleveland, O.

11:00 a.m.

Mechanism of Mass Transfer in Cathode Films During Electrodeposition, by *Robert R. Banks* and *Henry B. Linford*, Columbia University, New York, N. Y.

11:30 a.m.

Electrodeposition of Metal Powders, by *Gustaf Wranglen*, Electrodeposition Section, National Bureau of Standards, Washington, D. C.

11:55 a.m.

Electrolytic Hexagonal Nickel, by *Ling Yang*, Frick Chemical Lab., Princeton University, Princeton, N. J.

12:30 p.m.

Electrodeposition Luncheon and Annual Business Meeting.

2:00 .p.m.

Improvements in the Electrowinning of Chromium, by *R. R. Lloyd*, *J. B. Rosenbaum*, *V. E. Homme*, *L. P. Davis*, and *C. C. Merrill*, Minerals Div., Bureau of Mines, U. S. Department of the Interior, Boulder City, Nev.

2:25 p.m.

The Effect of Pure Organic Compounds on Crystal Size in Copper Electrodeposition—I, by *Martin Chanin*, *William P. Roth*, *Herbert R. Roth*, and *John H. Lane*, Evansville College, Evansville, Ind.

2:50 p.m.

The Effect of Indium in Electrodeposited Chromium, by *Norman Hackerman* and *Tyleen Jensen*, University of Texas, Austin, Tex.

3:15 p.m.

Electrodeposition of Rhenium-Nickel Alloys, by *L. E. Netherton*, Victor Chemical Co., Chicago Heights, Ill. and *M. L. Holt*, Chemistry Dept., Univ. of Wisconsin, Madison, Wis.

3:40 p.m.

New Correlative Instrumental Analyses of Textures and Properties of Nickel Electrodepositing, by *George L. Clark*, Univ. of Illinois, Chicago, Ill., and *Stanley H. Simonsen*, Univ. of Texas, Austin, Tex.

4:05 p.m.

Preparation of Fine Wire by Electropolishing, by *William H. Colner*, *Morris Feinleib*, and *Howard T. Francis*, Armour Research Foundation, Illinois Inst. of Technology, Chicago, Ill.

PROSTHETICS RESEARCH

(*Concluded from page 73*)

auxiliary anodes in order to control current density in critical areas. Electroplating is carried on for comparatively long periods, sometimes overnight, and the constant current feature is intended to compensate for changes in anode to work spacing so that burning will not occur.

Rectifier Unit and Control

The rectifier unit used to supply D.C. for the variety of processes described above is mounted on caster wheels. The external links on the side of the rectifier cabinet provide a choice of four ranges:

0- 16 volts, 150 amperes maximum
0- 32 volts, 75 amperes maximum
0- 50 volts, 50 amperes maximum
0-100 volts, 25 amperes maximum

Over any range, from zero to maximum, the output voltage may be continuously varied from the remote control unit (Figure 1) either manually or in conjunction with automatic stabilization.

Either voltage may be stabilized, or current (amperes) may be stabilized, depending upon the position of the "Control Selector." The "program" position of this switch is used for automatic control of the anodizing process. During the early stages of anodizing, the current is maintained constant at a predetermined value, with voltage automatically increasing to compensate for the increasing resistance of the anodic film. At any desired preselected voltage, control automatically shifts from constant current to constant voltage, and the voltage is then maintained constant until the process has been completed.

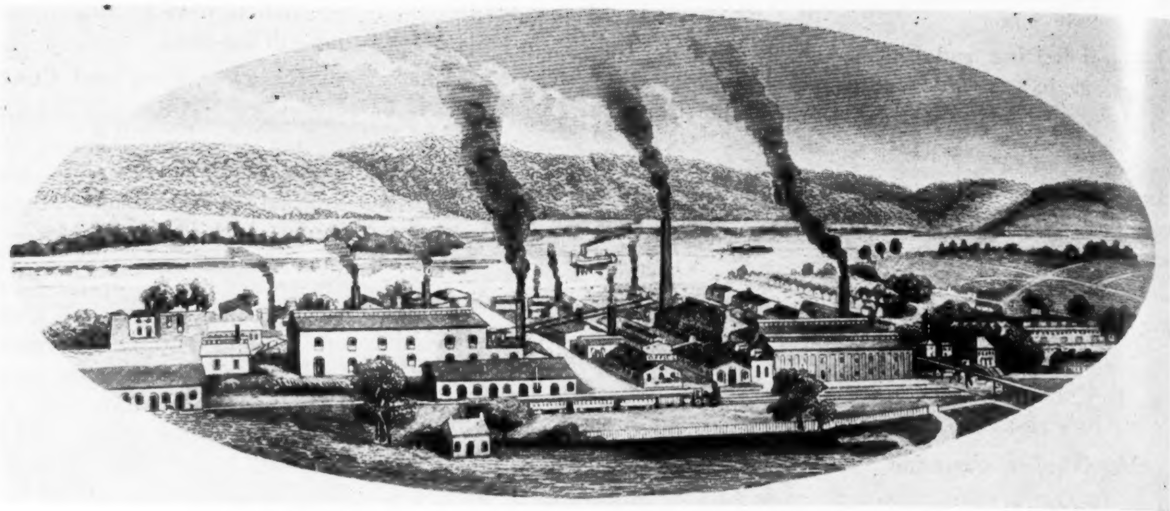
A voltmeter and an ammeter are provided on the control unit, and each is equipped with a switch so that any one of three meter ranges may be selected. Selection of a meter range automatically adjusts the "tolerance" of the associated stabilization circuit to correspond to the meter range. This tolerance is always equal to $\pm$ 1% of the maximum value of the range. Thus the voltage ranges and tolerances are:

0- 10 volts, stabilization to $\pm$ 0.1 volt
0- 50 volts, stabilization to $\pm$ 0.5 volt
0-100 volts, stabilization to 1 volt

The three current ranges and corresponding stabilization tolerances are:

0-15 amperes, stabilization to $\pm$ 0.15 ampere
0-50 amperes, stabilization to $\pm$ 0.50 ampere
0-150 amperes, stabilization to $\pm$ 1.5 ampere

The operator, in selecting a convenient meter range, automatically (and without thinking about it) switches in a suitable stabilization network so that excellent voltage or current stabilization is obtained over unusually wide ranges.



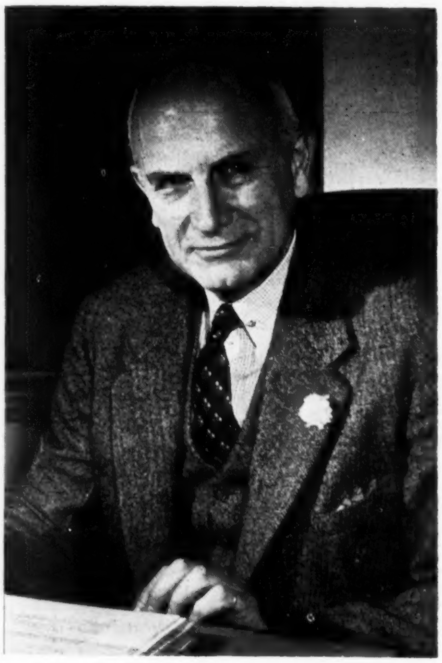
Steel etching showing the first plant of Pennsalt's at Natrona, Pa. as it looked in 1872.

Pennsalt Celebrates 100th Anniversary

ONE hundred years ago, on September 25th, five young Philadelphia Quakers thought they had found the way to success in a new venture—an American chemical company to supply the needs of the rapidly expanding economy and industry of the Midwest. They had a patent for a process of making alkalies from salt, $100,000 in capital raised among themselves and 12 friends, a plant site over salt deposits near Pittsburgh—gateway to the West—and almost boundless courage and hope.

Within five years the process had proved a failure and virtually their entire investment appeared lost. But somehow they summoned the courage to put up more of their own money and give it one more try. Today their company, the *Pennsylvania Salt Manufacturing Co.*, is one of America's leading basic chemical manufacturers, producing at its century mark at the rate of $38,000,000 worth of products a year for nearly every industry in the country. The bright dream has come true beyond anything they envisioned.

Pennsalt is one of the oldest chemical companies in continuous operation in the United States. It was the first chemical manufacturer chartered (September 25, 1850) under Pennsylvania's first general incorporation law of 1847. The company's name is a result of provisions of this statute, for, while it was entitled "general," it provided only for the incorporation of companies to manufacture wood, iron, paper, textiles or salt, "and articles resulting therefrom." No provision had been made for chemicals, but the section dealing with salt brought the infant corporation within the law. Credited with being founders of the company are *George Thompson Lewis* and his brother-in-law, *Samuel Fox Fisher*. It was they who hopefully purchased an untested patent for making alkalies, interested others in investing funds and organized the new company. Together with *Charles Lennig*, already a chemical manufacturer in Philadelphia, *George Garson* and *Samuel Simes*, they formed the first Board of Directors, with Lennig as Pennsalt's first president.



George B. Beitzel
President, Pennsylvania Salt Mfg. Co.

The first plant was built at East Tarentum, now Natrona, 21 miles up the Allegheny River from Pittsburgh on land yielding both salt and coal. Its principal product was to be caustic soda. Because British and other European chemicals dominated the markets of the East, the founders looked to the growing centers of Pittsburgh, Detroit, Cincinnati and the Midwest for their markets, and the marketing orientation of the company has generally followed this direction ever since.

When their first process failed, the company converted to the conventional LeBlanc process, but losses had nearly wiped out the original investment. Some way to make a profit had to be found quickly. Lewis hit upon the idea of supplying household-sized packages of lye for home soap making. This would provide a great improvement over the then prevailing method of using leachings from wood ashes. In 1855, with the aid of more capital advanced by Lewis, the company produced small cans of household lye. They proved an instant success, so much so that in 1856 Pennsalt had its first profitable year. It has earned a profit every year since.

At first profits were ploughed back

to increase plant and equipment, improve the process and add new products. In 1863 Pennsalt paid its first dividend and has paid common stock dividends continuously ever since, one of the longest dividend paying records in American manufacturing.

Following its successful venture with household lye, Pennsalt in the 1860's entered another field, the refining of petroleum to supply kerosene for home lighting. Refineries were set up at Natrona and it is generally believed that the first refined petroleum product exported from America was 500 barrels of Pennsalt's "*Natrona Oil*," a kerosene. The wild fluctuations of the crude oil market of the time made this un-

Joseph J. Duffy, Jr., (left) Sales Mgr. of Pennsalt's Special Chemicals Dept., consults with William P. Drake, Vice Pres. in charge of sales.

profitable, however, and Pennsalt discontinued these operations in 1868. It is interesting to note that one of its chemists, who left the company at this time to continue his interests in petroleum, was *Henry H. Rogers*, later an associate of *John D. Rockefeller* in founding Standard Oil.

In 1864 Pennsalt made an agreement with the Danes to import cryolite from Ivigtut, Greenland, to add to its supply of raw materials for soda alkalies. Under continuously renewed agreements, Pennsalt has imported this interesting mineral from this source ever since. Cryolite immediately gave the young company a new product, alum, and added a flux to the products already being supplied Pittsburgh's iron and steel industry. But in 1888 its importance increased sharply when *Charles Martin Hall* discovered that in its molten state, cryolite was the electrolyte for producing aluminum. This use soon overshadowed previous uses and later the material also gained importance as an insecticide, as a flux, an opacifier and in the manufacture of abrasives.

In 1872, by then profitably established in the Middlewest, Pennsalt built its second plant at Greenwich Point, Philadelphia. This plant, operated until the end of World War II, and the Natrona plant were the scene of Pennsalt's small but interesting career in the field of metallurgy. Importing pyrites from Spain as a source of sulfur, the company extracted from this ore copper, gold, silver and iron. These operations ceased at Natrona when a fire destroyed the precious metals plant in 1894 and ended at Greenwich after World War I when the company began using domestic sulfur exclusively.

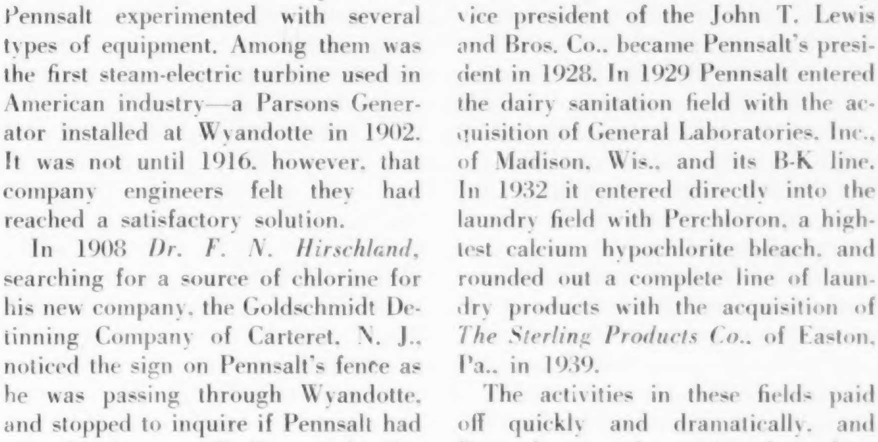
In the '90's Pennsalt President *Theodore Armstrong* determined to go into salt electrolysis for the production of caustic soda. In 1898, after examining several sites, the company purchased land over salt beds at Wyandotte, Michigan, and soon built an electrolytic plant there. A mercury cell first used was a failure. But in 1904 a young British engineer, *Arthur E. Gibbs*, offered the company his invention, the Gibbs diaphragm cell. Simple and successful, this was adopted and with modifications is today Pennsalt's principal method of producing caustic soda and chlorine. But the problems of supplying power for electrolysis were still far from solved. Like many others faced with these problems, Pennsalt experimented with several types of equipment. Among them was the first steam-electric turbine used in American industry—a Parsons Generator installed at Wyandotte in 1902. It was not until 1916, however, that company engineers felt they had reached a satisfactory solution.

In 1908 *Dr. F. N. Hirschland*, searching for a source of chlorine for his new company, the Goldschmidt Detinning Company of Carteret, N. J., noticed the sign on Pennsalt's fence as he was passing through Wyandotte, and stopped to inquire if Pennsalt had any chlorine to sell. For nearly five years Pennsalt had been looking for an outlet for the potentially large chlorine output of the Gibbs cell. Hirschland's company became Pennsalt's first large chlorine customer, and in 1909, after setting up a liquefaction plant on Pennsalt's Wyandotte property, this company shipped the first tank car of liquid chlorine ever to move on American rails. Soon thereafter chlorine's most beneficial use, the purification of drinking water was introduced. Then, with the advent of World War I, chlorine production facilities of America expanded greatly. Great strides were made in the use of chlorine for bleaching, especially of pulp, during the years immediately after the war. Taking an active part in this, Pennsalt developed one of the first methods of direct chlorination of pulp in 1924.

To serve the growing pulp and paper industry and other industry beginning to spring up in the Pacific Northwest, Pennsalt in 1927 purchased a plant site at Tacoma, Washington, and set up the *Tacoma Electrochemical Co.*, later the Pennsylvania Salt Manufacturing Co. of Washington, to manufacture chlorine and caustic soda.

Although research and diversification had always been basic Pennsalt policies, these policies were accentuated when *Leonard T. Beale*, formerly vice president of the John T. Lewis and Bros. Co., became Pennsalt's president in 1928. In 1929 Pennsalt entered the dairy sanitation field with the acquisition of General Laboratories, Inc., of Madison, Wis., and its B-K line. In 1932 it entered directly into the laundry field with Perchloron, a high-test calcium hypochlorite bleach, and rounded out a complete line of laundry products with the acquisition of *The Sterling Products Co.*, of Easton, Pa., in 1939.

The activities in these fields paid off quickly and dramatically, and Pennsalt not only continued to show



Pennsalt's Whitemarsh Research Laboratories, the former E. T. Stotesbury mansion in Chestnut Hill, Pa.

a profit through the depression years, but expanded all through this period. It was during this time that Pennsalt research developed Orthosil, its first special compound for metal cleaning, thus beginning a whole new line of industrial cleaners.

One of the early uses for the orthosilicate cleaners was in the cleaning of sheet steel for tinplate. Their first success was in tin mill cleaning lines running at the rate of 150 feet per minute. Now a successor product is operating just as successfully on lines running 2,400 feet per minute.

It is interesting to note that one of the first reverse-current cleaning cycles, developed at the Ford Motor Co. in 1937, used a Pennsalt cleaner. As development of the product grew, so did manufacturing procedures, and between 1937 and 1939 the company developed a modern, continuous cleaner plant at Wyandotte, Mich.,—centrally located for the metal working industry.

In 1939 the company formed the Pennsalt Cleaners sales department. With the addition of Pennsalt's corrosion-resistant cements and paints in 1941, this became the Special Chemicals Department. Today this Department handles more than 50 chemical specialties for the metal industry, including acid, alkaline and emulsion type cleaners; rust inhibitors; pickling and descaling compounds; maintenance cleaners, and corrosion resistant cements and paints. Research is adding more, not only in the field of cleaners but other chemicals for the metal industries.

In the late '30's Pennsalt decided to go into the manufacture of chlorates, chiefly for agricultural chemicals, in a new plant to be built at Portland, Ore. The new plant was successfully designed by Pennsalt's own engineers and went into production in 1941.

With the outbreak of World War II, all of Pennsalt's production was converted to war. Cryolite ships from Greenland soon were being convoyed by the U. S. Navy to assure ample supplies for aluminum production. As further insurance, Pennsalt built a synthetic cryolite and aluminum fluoride plant for the Defense Plant Corp. at Cornwells Heights, Pa., and also installed company-owned facilities for additional natural cryolite refining. Greatly expanded production took place at Cornwells, Easton and Greenwich in hydrofluoric acid—for the production of high-test aviation gasoline and, as it later developed, for the Manhattan Project.

War also brought intensive expansion of research activities. In 1944 Pennsalt purchased Whitemarsh, the large mansion built by E. T. Stotesbury in Chestnut Hill, near Philadelphia, and converted it into a research and development laboratory. It was here that Pennsalt completed initial work on production of DDT and other insecticides and pursued experimental work, begun several years before, in the field of fluorine chemistry. As a result of this, Pennsalt developed a successful electrolytic cell for generation of elemental fluorine, and in 1947 produced for commercial sales this most chemically active element known.

At the same time Pennsalt was acquiring extensive fluorspar deposits in Kentucky and planning a large basic plant for fluorine chemicals. In 1949 the plant was completed and went into operation at Calvert City, Ky. During the war Pennsalt also purchased a plant at Bryan, Tex., to produce arsenicals and other insecticides.

Today Pennsalt lists in its catalogues more than 300 products, ranging in package size from four-ounce bottles of bactericide to 75-ton tank cars of acids. It is a basic producer of heavy chemicals such as chlorine, caustic soda, hydrofluoric acid, sal ammoniac, refined cryolite, chlorates, ammonia, muriatic, nitric and sulfuric acids, hydrogen peroxide and others. In addition to the Heavy Chemicals Dept., company products are distributed through the Agricultural Chemicals Department—chiefly bulk insecticides and weed killers to large users or blenders; the Laundry and Dry Cleaning Department—sours, bleaches, dry cleaning compounds, blues and other products to commercial laundries and dry cleaners; the Special Chemicals Department, which handles metal cleaners, corrosion-resistant cements and paints, metal-treating compounds and maintenance cleaners; and through the B-K and Household Products Department, which sells diary sanitation products, insecticides for garden, home and small farms, cleaning compounds and Pennsalt's first profit producer, lye.

Under Pennsalt's policy of diversification, no one customer accounts for more than 3.25 per cent of sales; no product represents as much as 14 per cent of sales.

The present operating management is the youngest since the company's founding. The average age of Pennsalt's top 10 men is 43. It is headed up by *George B. Beitzel*, president, with *Leonard T. Beale* as chairman of the board.

Summing up Pennsalt's first century in his history of the company, "Prologue to Tomorrow," *Robert Leavitt* wrote:

"Pennsalt is no giant; it is no prodigy. But it is important because it is the typical American firm in the same sense that any good man or woman is the typical American citizen. Like the neighbor whom you like and respect, it has had its homely, real-life adventures, its privately faced trials, its modest triumphs. But these are not in themselves one-half as important as what they show—that your friend is a good man, a good neighbor and a good citizen of a country that is great because there are so many like him."

Improving End-Point in Drop Test for Cadmium Thickness

In determining the end-point, or first penetration of the coating, when using the dropping method of testing cadmium plating thickness on steel, some difficulty is often encountered, due to poor contrast between the steel base and the cadmium plate.

A drop or two of the following solution, applied to the test spot when complete solution of the coating is suspected, will verify the end-point:

Mercuric chloride	10 gm.
Hydrochloric acid	50 ml.
Water	to make 100 ml.

The effect produced is a bright spot of mercury at the point where the coating has been dissolved and the steel base exposed, and a blackening of the surrounding cadmium plating. If the solution should be applied before the cadmium is perforated (results negative), a new spot should be selected for the second test.

Before applying this mercury test, any dark residue left from the attack of the test solution on certain types of cadmium plating where addition agents have been used, should be rubbed off with a piece of dry filter paper.

(From Journal Electrodepositors Technical Society, 1950, 25, 39)

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

Shop Problems

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Spot-Free Drying of Plated Parts

Question: The water in our section of the country is very hard and contains minerals, which gives us trouble in trying to dry our highly buffed plated work without spots. We know the method of using a water-dispersing material followed by degreasing, but as we do not have a degreaser, we would welcome any other suggestions as to how we can overcome this problem.

T. E. J.

Answer: Several methods are available when you don't have a degreaser. You can have the final rinse in a spray of either distilled or de-ionized water. In this case the next to last rinse should be in hot water, so that the heat retained by the parts will evaporate the final pure rinse water from the parts. Infra-red or other drying techniques can then follow to insure perfect dryness if required. Another method when pure water is not available is to rinse in a final cold water running rinse, then blow off the excess water from the parts with compressed air, or spin the parts in a centrifugal type drier to remove most of the water. The parts should be cold when blown off or spun, so as to prevent as much drying as possible. The final drying is then done in an oven or by infra-red lamps. The compressed air blow-off method is the least desireable, as it cannot do a perfect job. Furthermore, it is not applicable to many types of light, flimsy parts that might fly off the racks, and it introduces the possibility of dirt or oil spots from the compressed air if the air lines become fouled. For parts that can be sawdust tumbled, this method can be used, but here again the sawdust must be kept from becoming contaminated and should be changed frequently.

Hard Chrome Plating Rifle Bores

Question: We are interested in the possibilities for hard chrome plating the bores of small caliber rifles, from .22-.45 caliber, as there would seem to be an advantage to such a practice. Can you give us any information on how this is done?

A. O. P.

Answer: While we have heard that chrome plating of rifle bores has been done satisfactorily, there has been no published material on the exact methods and techniques used. It would undoubtedly require a very special racking and anode set-up, due to the smallness of the bore and the poor throwing power of the chrome bath. We are forwarding the names of several firms and individuals who may be able to furnish some details on the procedure.

Coloring Cadmium Plated Parts

Question: We are interested in producing oxidized effects on cadmium plated items, and wonder whether you can furnish formulas for doing this type of work. We would like most to have information on browns and blacks.

O. I. S.

Answer: There are a number of proprietary methods available from commercial suppliers for coloring cadmium plate brown and black. Names of these suppliers are being forwarded.

In addition, the following baths can be used:

Brown

Potassium dichromate	1 oz./gal.
Nitric Acid	½ "

Time—2-4 minutes with the bath at 150-160°F.

Brown

Copper sulfate	¼ oz./gal.
Ferric chloride	2 "
Hydrochloric acid	10 fl. oz./gal.

Immerse parts and allow to dry without rinsing. Repeat until desired shade is obtained.

Brown

Potassium permanganate	40 oz./gal.
Ferric chloride	3 "
Cadmium nitrate	15 "

Bath at 180°F. Parts should be colored immediately after plating.

Black

Lead acetate	¼ oz./gal.
Sodium thiosulfate	12 "

Black

Copper sulfate	2½ oz./gal.
Potassium chlorate	3 "
Sodium chloride	3 "

Use at 180-200°F. Several seconds immersion.

Test for Sealing of Anodized Aluminum

Question: We would like to know if there is any way of testing anodized aluminum parts to see if they have been given a sealing treatment after anodizing and how effective the sealing treatment is. We would also like to know if there is any way of removing the sealing effect without removing the oxide coating?

A. T. C.

Answer: The sealing treatment renders the anodic coating non-absorptive to dyes, and a test based on that fact is as follows:

A drop of violet dye solution, made by dissolving 1 gram of Anthraquinone Violet R in 50 ml. of distilled water, is applied to the part being tested. If, after standing five minutes

and rinsing and rubbing the test spot with soap and water, any color remains it is evidence that the coating was either not sealed or improperly sealed. It is essential that the spot being tested has not been contaminated with oil or by handling.

This test method is given in more detail in A.S.T.M. Spec. B136-45. To the best of our knowledge there is no way of de-sealing an oxide film on aluminum alloys without stripping the film and re-anodizing.

Stripping Indium Plating

Question: We have been experimenting with some plating of indium for decorative purposes and would like to know what is the best way to strip deposits of this metal?

R. W. A.

Answer: The method used for stripping indium and the degree of success achieved depend on whether or not the indium plating has been diffused into the base metal by heat treatment after plating. Undiffused indium plating over copper-base alloys can usually be stripped easily with conc. hydrochloric acid. Diffused coatings cannot be removed this way. Undiffused indium plating can be removed from steel by using a reverse current treatment in a solution of sodium cyanide, about 4 oz./gal.

Hard Silver Plating

Question: We are plating silver on aircraft engine parts, and it has been questioned whether or not our silver deposits are as hard as those obtained in other plants. We are of the impression that all commercial silver deposits are about equal in hardness, and would like your advice on this point.

R. B. S.

Answer: (by *Frank C. Mesle*, Oneida Ltd.): Silver, as with other metals, is harder as the grain size is smaller, and plating conditions can be varied to give finer grained silver deposits, and hence harder deposits. To produce a fine-grained silver deposit it is necessary to plate at the maximum current density that is compatible with the other plating conditions such as temperature, bath concentration, etc. I would estimate that it would be possible to get a difference of about 10-15 points on the Rockwell E scale between fine-grained and coarse-grained deposits of silver.

Water Spots on Bright Finishes

Question: We are troubled occasionally with spots appearing on our bright plated work after drying. This only happens on some of our highest finish parts, and we have been hand wiping the spots off. We realize that by using distilled or de-ionized water this problem would be eliminated, but we want to avoid this expense for the few types of parts that cause us trouble. Is there anything else we can do to help ourselves out of this nuisance?

C. S.

Answer: De-ionized water is, of course, the best solution for this common problem. However, you can help yourself considerably by removing as much as possible of the highly mineralized water from the parts *before* drying. This can be done by using a final *cold* rinse and *cold* air blowoff before drying the parts.

A small amount of pure water, either distilled or demineralized, can be used as a final rinse, after the cold air blowoff, for even better results. Another method of removing excess water after cold rinsing would be to use a centrifuge-type dryer without heat.

Chemical Immersion Nickel Films

Question: Can you give us any formulas for immersion nickelling of steel parts? We only need a thin film. We know about the Hypophosphite type of solution, but wonder if there is anything cheaper that could be used?

F. T.

Answer: The following bath will deposit a thin (approx. .00003") film of nickel on steel or iron parts.

Nickel Chloride	96	oz./gal.
Boric Acid	4.8	
pH	3.5-4.5	
Temp.	70°C.	

Films by this method are somewhat porous, but this can be lessened by heat treating the film. Any non-metallic inclusions on the surface of the steel will prevent deposition in that area. Films produced by this method would not be suitable for protective or decorative purposes without subsequent treatments.

PATENTS

Improving Selenium Rectifier Cells

U. S. Patent 2,497,649. *R. D. Amsden, assignor to General Electric Co.*

The method of improving the rectifying characteristics of a selenium rectifier cell which consists in conducting therethrough electric pulsations having a polarity opposing the blocking characteristic of said cell and during said treatment maintaining said cell at approximately 80°C. independently of the heat developed by said pulsations.

Racking Arrangement for Uniform Plating of Concave Objects

U. S. Patent 2,500,205. *R. A. Schaefer, assignor to The Cleveland Graphite Bronze Co.*

In a method of electroplating a uniform layer of metal of approximately .005 inch or less thick upon the concave surface of a semi-cylindrical article, the steps which consist of placing the parallel edges of the article against and with the concave side facing, an insulating barrier element having a slot opening parallel to and centrally located with respect to the lateral edges of the article and being otherwise impervious to the passage of current, the width of said slot being approximately 25% or less of the diameter of the article, immersing the article and barrier element in an electroplating bath, mounting an anode in the bath external to the article and passing a plating current from said anode to said article as a cathode through said slot.

Immersion Gold Plating

U. S. Patent 2,501,737. *R. W. Porter, Jr. and C. M. Jones.*

A solution for plating metals with gold by immersion only, comprising before the dissolution thereof in distilled water, the following ingredients in substantially the proportions by weight hereinafter stated, to wit, gold chloride .79%, tribasic sodium phosphate 9.63%, potassium cyanide 9.63%, acetic acid 3.82%, and distilled water 76.13%.

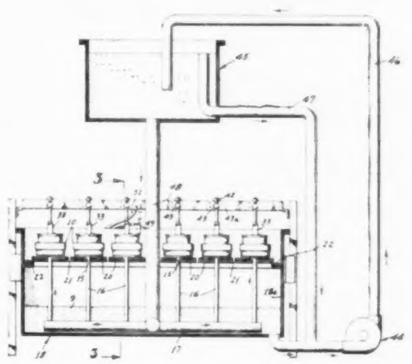
Phosphating Composition

U. S. Patent 2,502,441. *S. R. Dodd, and R. F. Ayres, assignors to Oakite Products, Inc.*

A phosphating composition comprising an acid salt of phosphoric acid and a water soluble compound selected from the group consisting of molybdic acid compounds and tungstic acid compounds and a phenol, said latter two ingredients each being present in a quantity ranging from 0.1% to 10% of the quantity of acid salt of phosphoric acid.

Plating Copper-Bottomed Stainless Cooking Utensils

U. S. Patent 2,502,495. *H. Waterman, assignor to Norris Stamping and Mfg. Co.*



An apparatus for electroplating copper on the bottom and rounded bottom corner surfaces of a stainless steel cooking utensil which is cylindrical with a flat bottom having a rounded bottom corner surface comprising an electrolyte containable cylindrical plating cell open at the top and having an inside diameter greater than its depth and greater than the outside diameter of the utensil to be plated, said cell having a dielectric side wall and a bottom, provided with an upper anodic surface, an electrolyte supply pipe vertically entering said cell through the center of the bottom thereof and having a discharge terminal in said cell adjacent the bottom thereof, means to supply electrolyte through said pipe to said cell at a substantially constant velocity, means to receive electrolyte overflowing the top of said cell and to re-circulate said electrolyte through said plating apparatus, electrical connecting means for conducting plating current to said anodic surface of the cell bottom, said cell bottom being adapted to support in conductive relation a supply of anodic plating copper of irregular shape, electrical conducting means adapted to suspend the cooking utensil to be plated stationary concentricly in the upper portion of said cell whereby the bottom of said utensil to be plated is positioned at a depth below the top of the side wall whereby plating will occur to the desired height up the side wall of the utensil and to define in conjunction with the upper portion of said plating cell an annular passage, and an annular dielectric guard ring in the upper portion of said cell extending inwardly from said side wall and having a central opening less than the diameter of the flat bottom of the utensil to be plated adapted to prevent upward flow of electrolyte against said utensil except through said opening and to cause the path of travel of plating current from the anodic cell bottom to the corners of said utensil to be longer than the travel of said current to the flat bottom of the utensil.

Preserving Luster of Zinc and Cadmium Plating

U. S. Patent 2,502,476. *L. H. Ott and J. T. Shewbridge, assignors to Rheem Mfg. Co.*

An aqueous solution for use in the treatment of metals selected from the group consisting of zinc and cadmium to preserve the luster thereof and reduce oxidation consisting essentially of a 1:1 ratio of an equal number of grams of chromium trioxide to an equal number of milliliters of hydrochloric acid (36 to 38%).

Treating Brightened Tinplate

U. S. Patent 2,503,217. *A. F. Prust, assignor to Republic Steel Corp.*

The method of treating elongated brightened electro-tinplate which comprises the steps of making the tinplate a cathode, moving such tinplate endwise and successively deoxidizing tin surfaces thereof electrolytically in an aqueous, hexavalent chromium electrolyte, covering the thus deoxidized surfaces with a steam atmosphere while passing the tinplate from the electrolyte into and out of a body of washing liquid and thereby protecting said surface by said atmosphere against oxidation and substantially completely drying them after they pass out of the washing liquid, heat-

ing said surfaces for less than about one second to remove final moisture therefrom and forming an oil coating on said surfaces.

Recovering Silver from Solutions

U. S. Patent 2,503,104. *E. Farber, assignor to Timber Engineering Co.*

A process for recovering silver from dilute solutions thereof which comprises incorporating in the dilute solutions a precipitant produced by subjecting cellulosic substances containing hemicellulose and lignin to the action of a dilute mineral acid under conditions requisite to effect hydrolysis of the hemicellulose, adjusting the pH of the mixture of silver solution and precipitant to at least about 9, and recovering the silver precipitated from the mixed solutions.

Iron Plating Bath

U. S. Patent 2,503,235. *J. R. Cain, assignor to Sulphide Ore Process Co., Inc.*

Method of electrodeposition of iron from a non-diaphram cell using an insoluble anode, comprising passing an electric current through an aqueous electrolyte solution consisting essentially of ferrous chloride, maintaining the electrolyte in the ratio of 100 parts ferrous iron as ferrous chloride to .1 to 3 parts ferric iron as ferric chloride with free hydrochloric acid in amount not to raise the pH above pH 2, continuously withdrawing the electrolyte from the cell and contacting it with a pyrrhotitic ore to reduce the concentration of ferric iron to 0.1% to 1% of the total iron concentration of the electrolyte and increasing the concentration of ferrous chloride, filtering the leach liquor and continuously returning same containing the increased concentration of ferrous chloride, the decreased concentration of ferric chloride and with substantially the same hydrochloric acid concentration and pH value to the cell, the circulation of the electrolyte being at a rate to maintain the above-described concentration thereof substantially constant.

Purifying Zinc Solutions

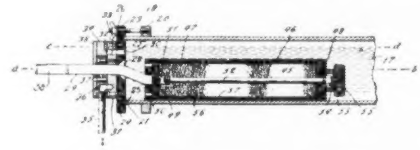
U. S. Patent 2,503,479. *D. L. Griffith and M. J. Rankin, assignors to Hudson Bay Mining and Smelting Co.*

A method of removing impurities from zinc electrolyte solutions comprising adding to the electrolyte small amounts of zinc dust, copper sulphate, a soluble compound of antimony and from about 50 to about 200 milligrams per litre of lead in the form of a soluble compound.

Plating Internal Surfaces of Pipe

U. S. Patent 2,503,863. *S. G. Bart.*

Apparatus for lining the bore of a pipe by electrolytic deposition, including a set of rollers coacting to form a cradle on which the pipe is mounted for rotary movement about a horizontal axis, power means operatively connected to at least one of the rollers to turn the same and therethrough to ro-



tate the pipe, an anode structure of cylindrical form, having a diameter materially less than the internal diameter of the pipe, located entirely within the pipe and free to rotate about an axis parallel to the axis of rotation of the pipe, said anode structure including means forming an anode and at least one roller of insulating material secured to the anode to turn therewith in rolling engagement with the pipe and insulating the anode therefrom, said anode structure and pipe supporting one from the other and otherwise independent of each other and thus capable of relative movement both rotatively and axially, closure means for closing opposite ends of the pipe to contain within the pipe all of the plating electrolyte, said closure means provided with conduits for introducing the electrolyte into and for discharging the electrolyte from the interior of the otherwise closed pipe, means for temporarily securing said closure means to opposite ends of the pipe, a cable intruded through one of the closure means at the axis of rotation of the pipe for supplying electric current to the anode of the anode structure, the portion of the cable within the pipe being sufficiently flexible to permit its inner end to follow the adjacent end of the anode structure in all positions of the same relative to the pipe as the anode structure rolls on the pipe and means for connecting the exterior of the pipe and the cable to a source of electric energy.

Preventing Tarnishing of Silverware

U. S. Patent 2,503,843. *L. D. Robertson and J. W. Robertson.*

The method of preventing silverware from tarnishing which comprises exposing the silverware in a confined space to vapors of the anhydrous crystalline reaction product of morpholine and carbon dioxide in an anhydrous medium.

Nickel Plating with Welded Nickel Anodes

U. S. Patent 2,504,239. *E. J. Roehl, assignor to The International Nickel Co., Inc.*

The method of electrodepositing nickel with a welded electrolytic nickel anode which comprises establishing an aqueous nickel electroplating bath having a pH up to about 4.0, a chloride normality of about 0.4 to about 2.8, and a nickel sulfate content corresponding to 300 to 29 grams per liter of $NiSO_4 \cdot 7H_2O$, said pH and chloride normality being correlated to fall under curve A in the accompanying Fig. 3; immersing in said nickel electroplating bath a welded electrolytic nickel anode comprised of a plurality of portions of electrolytic nickel welded together with at least one nickel weld metal joint, said welded anode being so immersed in said bath that said nickel weld metal joint is exposed in contact with said electrolytic nickel to said nickel electroplating bath, said nickel weld metal containing about 0.1 to 2% silicon, about 0.03 to 1.3% carbon, about 0.05 to 2% titanium, up to about 2% aluminum, up to about 2% manganese, about 0.04 to 0.12% magnesium, with the balance essentially nickel constituting at least 97% of the weld metal, said electrolytic nickel being the type produced from a sulfate-chloride electrolyte and containing about 0.001% iron, about 0.003% to about 0.005% copper, about 0.01% to about 0.1% cobalt, with the balance essentially nickel; and passing a plating current from said welded anode to a cathode immersed in said nickel electroplating bath to anodically corrode said welded anode without producing preferential corrosion of said nickel weld metal with respect to said electrolytic nickel of said welded electrolytic nickel anode.

Engineering Information Useful In Designating Metallic Surface Treatments

Engineering Data Sheet

Making Additions to Plating Solutions

This table gives the number of **pounds** of any chemical required to bring a bath up to specifications, for various sizes of tanks. Find the number of oz./gal. to be added, then read straight across to the column under the correct size tank to get the total pounds. In-between size tanks can be estimated closely enough for practical purposes. Amounts of additions higher than given in this table can be calculated from these figures. For example, an addition of 18 oz./gal. to an 800 gallon tank would require twice as much chemical as the addition of only 9 oz./gal. to an 800 gallon tank, or 900 lbs.

TANK SIZE GALLONS

oz./gal. to be added	100	200	300	400	500	600	700	800	900	1000
0.5	3.1	6.3	9.4	12.5	15.6	18.8	21.9	25.	28.1	31.2
1.0	6.2	12.5	18.8	25.	31.2	37.5	43.8	50.	56.3	62.5
1.5	9.4	18.8	28.2	37.5	46.9	56.3	65.6	75.	84.4	93.8
2.0	12.5	25.	37.5	50.	62.5	75.	87.5	100.	113.	125.
2.5	15.6	31.2	46.9	62.5	78.1	93.8	109.	125.	141.	156.
3.0	18.8	37.5	56.3	75.	93.8	113.	131.	150.	169.	188.
3.5	21.9	43.7	65.6	87.5	109.	131.	153.	175.	197.	219.
4.0	25.	50.	75.	100.	125.	150.	175.	200.	225.	250.
4.5	28.1	56.2	84.4	113.	141.	169.	197.	225.	253.	281.
5.0	31.2	62.5	93.8	125.	156.	188.	219.	250.	281.	312.
5.5	34.4	68.7	103.	138.	172.	206.	241.	275.	309.	344.
6.0	37.5	75.	113.	150.	188.	225.	262.	300.	338.	375.
6.5	40.6	81.2	122.	163.	203.	244.	284.	325.	365.	406.
7.0	43.7	87.5	131.	175.	219.	262.	306.	350.	394.	437.
7.5	46.9	93.8	141.	188.	234.	281.	328.	375.	422.	469.
8.0	50.	100.	150.	200.	250.	300.	350.	400.	450.	500.
8.5	53.1	106.	159.	213.	266.	319.	372.	425.	477.	531.
9.0	56.2	113.	169.	225.	281.	338.	394.	450.	506.	562.
9.5	59.4	119.	178.	238.	297.	356.	416.	475.	535.	594.
10.0	62.5	125.	188.	250.	312.	375.	438.	500.	563.	625.

Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries

Chemical Stripper for Removing Nickel, Lead Tin and Chromium from Copper Base Alloys

Enthone, Inc., Dept. MF, 442 Elm St., New Haven, Conn.

This firm has announced the development of a new product for the rapid stripping of nickel, tin, lead, tin-lead alloys, and chromium from copper, brass and other copper alloys without attack upon the base metal. The process involves no current. The work to be stripped is immersed in an acid solution containing Metal Stripper N-165 and rapid removal of nickel and the other metals mentioned is accomplished. Stripping rates as high as 0.006" per hour of nickel have been claimed. The process is stated to be ideal for removal of nickel from bulk plated work as well as heavier plated objects made of copper. It is also suitable for removal of nickel and chromium from tips of plating racks. Copper plating will not be stripped. The process is not suitable for removal of nickel from steel or zinc base alloys. (Enthone's Metal Stripper "A" is recommended for removal of nickel from steel without attack.)

Enthone Metal Stripper N-165 is supplied as a neutral powder safe to handle and easy to use. One-pound is added to each gallon of 10% acid solution. Stirpping can be done at room temperature or at higher temperatures if faster stripping is desired.

Corrosion-Resistant Finish for Aluminum Alloys

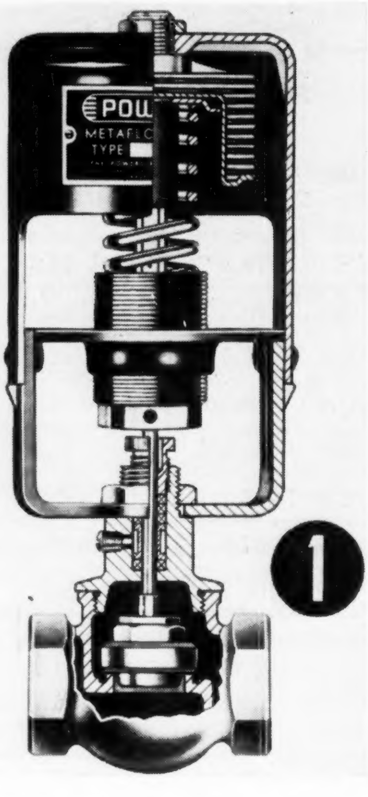
Pyrene Mfg. Co., Dept. MF, 12 Empire St., Newark 8, N. J.

This firm announces a process for the surface protection of aluminum alloys, known as the Pylumin Process. The coating is imparted in a simple immersion, requiring no current. Ordinary steel tanks can be used, and the solution is maintained, through the addition of a single chemical, by means of a simple test kit supplied to users. The bath is said to clean the surface of the parts at the same time that the protective coating is being applied. Complete details may be obtained by writing to the above address.

Air Operated Control Valves

Powers Regulator Co., Dept. MF, 2779-A Greenview Ave., Chicago 14, Ill.

This firm announces their new Metaflow air-operated control valve for



steam, water, oil, or gasses, where pressure differentials do not exceed 75 psi. Small, light in weight, and reasonably priced, the valve incorporates a cast bronze body capable of standing pressures up to 125 psi., stainless steel stem in preformed lubricated metallic packing, brass adjusting screw and rust-proofed steel spring having a 15 lb. adjusting range. Complete specifications are available from the above firm.

Hard Gas-Carbon Anodes

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

When carbon anodes are required, pure hard gas-carbon anodes should be used. The carbon anodes made by the above firm are recommended for black nickel solutions operated at room temperature and at relatively high pH. These anodes are hard, and act as a ready conductor of both heat and current.

They also are recommended for use in purification when carbon anodes are used. The standard size carbon anode is 3/8" thick, three or six inches wide, and 12", 18" and 24" lengths.

Hydraulic Motor Valve

Sarco Co., Inc., Dept. MF, 12, 350 Fifth Ave., N. Y. 1, N. Y.

The Sarco Co. announces the introduction of a new electro-hydraulic motor valve for open-and-shut control. Two-wire, normally closed, for direct connection to 110 Volts A.C., 60 cycle current.

This valve is designed for automatic operation by thermostats or pressurstats or by liquid level or flow controls. As a shut-off valve in an inaccessible location, it can also be actuated by a push-button. The Sarcostat valve is constructed to handle steam, water, oil, gas, air, etc.

The valve operator, actuated by hydraulic power, operates single seated valves up to 1½", or double seated valves up to 4" at 125 psi. It does this by direct thrust—without resort to pilots, gears or levers. Also available with an adjustable stop for partial throttling.

Operators are dust-moisture and fume-proof. They also can be furnished explosion proof. Ask for bulletin #10-80A which is printed in two colors and contains cross-sectional drawings, capacity charts, prices and detailed information.

Bright, Lustrous Corrosion-Resistant Dip for Zinc Plated Parts

The Chemical Corp., Dept. MF, 54 Waltham Ave., Springfield 9, Mass.

A brilliant, corrosion-resistant finish

on zinc plate for 1/5 of a cent per square foot is the leading claim of this firm. for its new Utility-15 Zinc Bright Dip.

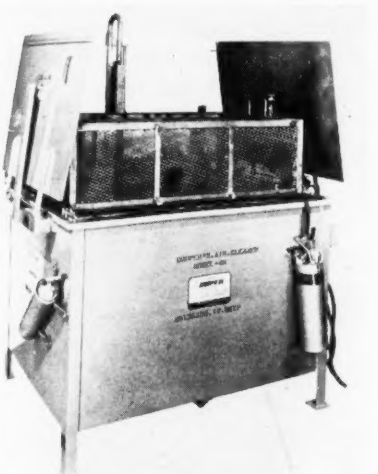
This new dip may be diluted up to ten times without loss of brilliance or corrosion-resistance, it is claimed. The solution is 95% inorganic materials and hence very stable. Great uniformity of results and freedom from iridescence are also claimed.

The company will process samples free of charge and will send literature and technical data upon request.

Agitating-Dipping Machine

D. C. Cooper Co., Dept. MF, 1467 S. Michigan Ave., Chicago 5, Ill.

This firm announces the development of a Pneumatic Agitating & Dipping machine, especially designed for



automatic cleaning of metal parts, fingerprint removing, dipping of spare parts in rust preventives, oils and grease, and dipping of packages in wax.

The machine consists of a sturdily constructed steel tank, with bottom drain and overflow near top. The machine is equipped with air cylinder for operating rack. Special valves and switches control the various operations of the rack.

By a simple push button operation, the rack will lower to bottom of the tank and automatically start agitating. By pushing button, agitation can be stopped and rack raises flush with top of tank for loading and unloading.

The machine is equipped with a rectangular, removable frame fitting within the inside area of tank, designed to support a platform, basket or both. The basket and rack are removable and

interchangeable, and of heavy duty construction.

The agitation consists of a vertical stroke of approximately 5 inches, with a speed of 18 to 20 strokes per minute, as a normal working speed. Speed can be adjusted faster or slower as desired.

Complete descriptive literature is available on request.

Buckets for Handling Corrosive Chemicals

U. S. Rubber Co., Dept. MF, Rockefeller Center, N. Y. 20, N. Y.

Unbreakable buckets for carrying corrosive chemicals, made of Enrup, a tough, new thermosetting blend of plastic and rubber, are now being produced in quantity by the above firm.

The buckets are claimed to be lighter and tougher than hard rubber varieties, and will not crack or shatter under severe abuse.

They will resist aliphatic solvents, all concentrations and types of alkalies, most acids and other corrosives up to

temperatures of 150 degrees Fahrenheit, it is claimed. They are not designed for carrying formic, glacial acetic or concentrated nitric and sulphuric acids. However, nitric and sulphuric acids in concentrations up to 50 per cent can be handled satisfactorily. They are not recommended for aromatic solvents, esters or ketones.

Produced in the 12 quart size, each has an Enrup handle which can be replaced if necessary.

Tape For Protecting Finished Surfaces

Minnesota Mining and Mfg. Co., Dept. MF, 900 Fauquier St., St. Paul 6, Minn.

A new "Scotch" brand No-Mar protective tape — designed for especially severe fabrication jobs, including deep

draws — has been announced by the above company.

It is applied to sheets of stainless steel to protect the surface against scratches and die marks during shipment, storage, fabrication, and after-fabrication shipment and storage. It is also used with other highly polished metals and some plated metals.

The tape has an adhesive that enables is to stick immediately upon contact, and that constitutes a rubbery protective film that stretches with the metal during fabrication, it is claimed.

The new paper backing eliminates wrinkling during even long periods of storage, thus avoiding possible scoring due to creased paper during fabrication, the "3M" company claims. Patterns can be easily traced on the backing, which is white.

The tape is furnished in 100-yard rolls in standard widths of 12, 24 and 36 inches, with other widths available on special order. The tape is applied directly from the roll and sticks in place immediately upon contact, according to the firm.

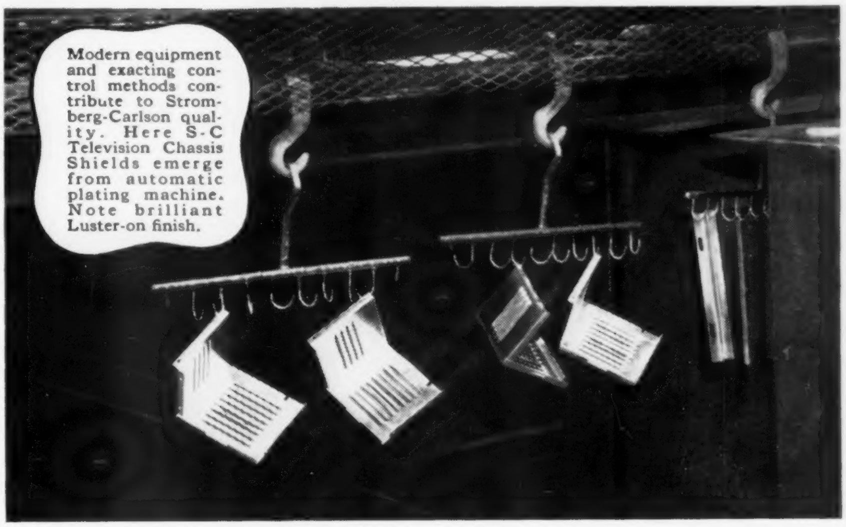
The new tape, No. 343, was announced as an addition to the firm's present "No-Mar" brand tape, No. 340, which is designed for less critical jobs.

Chemical Resistant Gloves

American Rubberizing Co., Dept. MF, 617 11th Ave., Minneapolis, Min.

Plastiglov, a plastic impregnated glove which is said to have wear-resistant qualities surpassing any rubber coated glove, is being introduced to the industrial and consumer markets by the above firm.

Waterproof and snag-proof, the form-fitting Plastiglov is claimed to be heat and flame resistant. It is also



claimed superior in tensile and tear strength and in abrasion, acid, and alkali resistance over leather or natural and synthetic rubber gloves now in use. Tests have revealed the ability of Plastiglov to withstand long exposures to corrosive materials without effecting the plastic impregnated coating, it is claimed.

Extruded Zinc Anodes

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

Extruded zinc anodes, either as cylinders for ball anode containers or in any desired length in elliptical form, bring many advantages to users, it is claimed.

Corrosion characteristics are considerably improved and the metal structure is more dense, according to this firm. They are 99.9% pure and are available in pure zinc ZX, or combined with aluminum to make the well-known H-VW-M ZAX anode. They will not polarize excessively or produce sludge, it is claimed. When these ZA anodes are used, solutions remain clean and metal concentration has a high degree of stability, according to this firm. They are recommended for use in both cyanide and acid zinc solutions.

Sawdust-Corn Cob Barrel Polishing Compound

Kube-Kut, Dept. MF, 625 Midland Ave., Garfield, N. J.

This firm announces a new barrel polishing medium for metals, plastics, rubber, wood, glass and other materials. The new medium is composed of hardwood (maple) in cube form (termed Kube-Kut) and dried, to which there now is added corn cobs macerated in cube form (termed Korn-Kube). Both materials are first thoroughly screened to remove dust sized particles (fines), and the mixture is said to combine the high absorption of the sawdust with the more tougher polishing action of the pulverized corn cobs. It is claimed that the mixture permits drying and polishing in a minium of time and at a low cost. A variety of mixtures are available to meet specific conditions. Further information on these materials is available, and recommendations for their use may be obtained by writing to the above address.

Polyethylene Lined Steel Drums & Pails

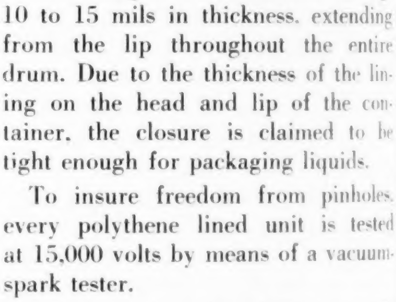
Delaware Barrel Co., Dept. MF, P.O. Box 1648, Wilmington, Del.

Polyethylene coated open-head drums, pails and hackneyes are now being produced and marketed by the above firm.

The lining is a continuous coating, 10 to 15 mils in thickness, extending from the lip throughout the entire drum. Due to the thickness of the lining on the head and lip of the container, the closure is claimed to be tight enough for packaging liquids.

To insure freedom from pinholes, every polythene lined unit is tested at 15,000 volts by means of a vacuum-spark tester.

Polythene has the ability to withstand shock, because of its elasticity.



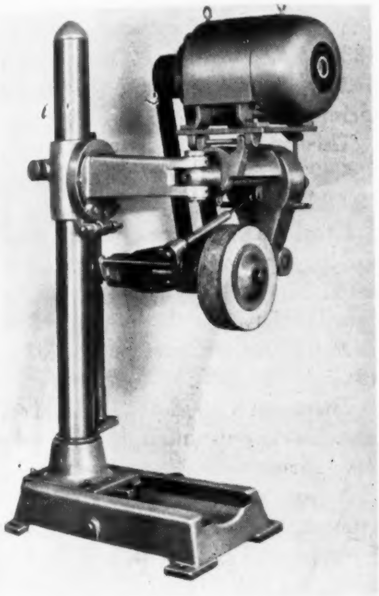
The lining will thus adhere to the steel units even if the container is damaged in transit. The lined unit can be re-used merely by washing out the inside.

This lining is claimed to resist muriatic acid, fluoboric acid, quaternary ammonium compounds, detergents, dye stuffs, sodium hypochlorite

solutions, hydrofluric acid, fatty acids, wetting agents, nitric acid, sodium hydroxide, ammonium hydroxide, sulphuric acid, formaldehyde, and many edible and non-edible products without any change in the packaged product or in the polyethylene lining.

Compact Polishing Heads With Three Year Spindle Guarantee

Murray Way Corp., Dept. MF, 3925 W. Fort St., Detroit 16, Mich.



This new, universal polishing or buffing head is designed to meet the need for a very compact, low cost head to economize on floor space but provide extreme versatility in use, according to the above firm.

These units, to be known as the 60 Series, will be made available in two standard sizes, Number 61 rated at 10 to 15 H.P., and the Number 62 rated at 5 to 7½ H.P. Both units will be of substantially the same design and features.

The new heads will operate either right or left hand, without extra brackets or extensive mechanical adjustment. A simple changeover can be quickly and easily made. The new heads, because of their extreme compactness, will operate on three-foot centers, thus greatly reducing the required diameter of dial-tables and permitting substantial economies in the length of conveyors and the number of fixtures required. Special pneumatic controls are said to assure constant, accurate work-pressure automatically.

The new head is so versatile in positioning and action as to be useable on practically any job, it is claimed. Further details may be obtained by writing to the above address.

Chemical-Resistant Coatings

Duramite Chemical Co., Dept. MF, 616-4½ St., Winston-Salem, N. C.

The Duramite line of chemical resistant coatings, claimed to be unique in their adhesion to various materials, heat resistance, and corrosion protection is being offered on a nation-wide basis by the above firm.

Duramite coating are easily applied solutions of chemically inert resins. Most acids, alkalies and other highly corrosive materials are without effect on these products, it is claimed. They are said to offer a distinct advantage over previous coatings in their exceptional adhesion and heat resistance. A specially compounded primer promotes good adhesion to any clean surface, and one group of products has been engineered to withstand temperatures as high as 300°F., according to the firm.

The line of Duramite coatings include high and low temperature products for industry, maintenance coatings for corrosive conditions, concrete and masonry finishes, floor coatings and custom-made coatings to fit the requirements of industry. These materials are manufactured in various colors to protect and identify equipment subject to corrosion.

A descriptive folder for your files is now available.

CASE HISTORIES

Actual Reports Available on Request

Eliminating Hand Work and Plating Rejects Caused by Inadequate Removal of Tripoli Buffing Compound from Zinc Die Castings

Parts to Be Cleaned: Zinc die castings for the hardware of one of America's finest cars.

Former Method: Parts were processed in a vapor degreaser, then electrocleaned before copper, bright nickel and/or chrome plating.

Present Method: Parts are immersed for 3 minutes in a 5 oz. per gal, solution of Magnus #7 at 180-185° F., then rinsed in hot water at 160° F. Electrocleaning follows.

Results of Operation Change: With the vapor degreaser, die castings could not be electrocleaned until hand brushing removed the buffing compound. Even then, plating rejects were high because of inadequate hand work. It was also felt that the cost of degreasing solvent was high.

Magnus #7 removes all traces of the tripoli compound. No hand work whatever is necessary. Plating rejects due to poor electrocleaning have been virtually eliminated, in spite of very rigid specifications set up by the car manufacturer. One tank of Magnus #7 lasts for four eight-hour shifts before accumulation of solids makes it necessary to make up a new solution.

The customer considers the change to Magnus #7 to have been a most profitable investment.

Maybe you are having trouble with a stubborn buffing compound. Magnus #7 may be the answer, but, if not, another of the specialized Magnus precleaners can be adapted to your problem.

For information write Magnus Chemical Company, 11 South Avenue, Garwood, N. J. In Canada — Magnus Chemicals Limited, Montreal. Service representatives in all principal U. S. cities.

Business Items

Stomber New Member of H-VW-M Administrative Staff

The *Hanson-Van Winkle-Munning Co.* of Matawan, N. J., announces the appointment of *Mr. James F. Stomber* as administrative assistant. Mr. Stomber brings to H-VW-M an excellent educational and business background, pointing toward the financial and statistical duties to which he has been assigned. He received his B.S. degree at New York University in 1943, majoring in foreign trade and marketing. From then until 1946, Mr. Stomber served in the Navy as a Lieutenant. From 1946 until he joined H-VW-M in 1950, his educational background on investments was used to good advantage with the Lee Higginson Corp., where he was assistant to the Vice-President and Comptroller as financial analyst.

James F. Stomber

3M Sales for Six Months Up 20% Over 1949

Net sales of the *Minnesota Mining & Manufacturing Co.* for the second quarter of 1950 reached a new high of \$33,336,428, with net income up to \$4,989,323, according to the firm's interim report.

This brought the six-month total to \$65,577,460 for sales, with a profit of \$9,682,389.

Earnings per share of common stock for the quarter were \$2.47, compared to \$1.53 for the same period a year ago. Earnings for the first half of 1950 were \$4.80 per share, against \$3.11 in 1949.

There were 1,976,342 shares of common stock outstanding at the end of the quarter.

A year ago, sales for the second quarter were \$27,667,435, producing a net income of \$3,114, 978. First half profit for 1949 was \$6,330,227 on sales of \$54,552,850.

Federal and state income taxes for the second quarter of this year were \$3,474,000 and for six months \$6,580,000. Last year's figures were \$2,275,000 and \$4,623,000.

Reynolds to Allocate Non-Military Use of Aluminum Alloys

All orders for aluminum for national defense purposes will be accepted and scheduled for immediate production, it was announced recently by *Richard S. Reynolds*, president of *Reynolds Metals Co.* "In conformity with the accelerated military program announced by President Truman we have pledged ourselves to give priority to meeting requirements for aluminum products essential to military preparedness," he said.

This policy will make it necessary to allocate metal to customers for civilian use, it was pointed out. It also may result in delay in filling some orders that have been accepted, since there are instances in which it may be necessary to divert materials in production in order to promptly meet urgent requirements of the national defense agencies.

Sales Promotion Manager. Mr. Conde will be located at the company's office at 204 W. Washington Street, Milwaukee 3, Wis.

Prior to his appointment at Brady-Milwaukee Co., Mr. Conde was advertising Manager of the Askania Regulator Co. A graduate of Purdue University, he was Managing Editor of "Modern Railroads" immediately following his graduation.

Canter Joins Chemicals Procurement Co.

Stuart J. Canter, formerly of Polytechnic Institute of Brooklyn, is now associated with *Chemicals Procurement Company*, 220 W. 42nd St., New York 18, N. Y.

The company acts as sales agents for specialty and intermediate chemicals. It also serves in the capacity of chemical broker.

Dr. Karl Schumpelt Joins Forstner Chain Corp.

After 21 years of service with Baker & Co., manufacturers of precious metals and precious metal plating baths, Dr. Karl Schumpelt, one of the world's foremost authorities on precious metal plating, has joined the Forstner Chain Corp. of Irvington and Union, N. J.. Dr. Schumpelt will organize and direct electrochemical and metallurgical research and production control. He will be retained by the Baker Co. as a consultant.

Blake Joins Detroit Chemical Specialties

C. H. McAleer, president of *Detroit Chemical Specialties, Inc.*, 9072 Livernois, Detroit announces that *Mr. Richard P. Blake*, formerly Division Manager of the McAleer Manufacturing Co., Rochester, Mich. is now associated with the Detroit Chemical Specialties, Inc.

Mr. Blake has eight and a half years plating experience and two years technical training at General Motors Tech. He attended Ohio State Univ.

Steiner New Research Co-Ordinator at Atlas Mineral

Mr. George L. Wirtz, president of the *Atlas Mineral Products Co.*, Mertztown, Pa., has announced the appointment of *Dr. Robert H. Steiner* as Research Coordinator. Dr. Steiner received his B.S. degree with highest honor at the University of Pittsburgh and his Ph.D. degree at the same institution. He has been employed by The Firestone Tire and Rubber Company for the past seven years.

Dr. Robert H. Steiner

Niagara Alkali Celebrates 50th Anniversary

This year marks the Fiftieth Anniversary of the *Niagara Alkali Co.*, according to *J. Clarke Cassidy*, president. Organized in 1900, under the name of the Robert Chemical Co., Niagara has pioneered steadily in its field of electrochemistry, specifically in relation to chlorine and similar products.

A notable contribution of the company has been to public health by the chlorination of water supplies. On No-

vember 22, 1912, it tried out the first successful apparatus for this purpose, in the City of Niagara Falls, which then had one of the highest death rates from typhoid of any city in the United States. Two years later, Niagara Falls was the envy of other cities as a healthy place to live.

The company, in addition to successful chlorination of drinking water, has a number of other firsts to its credit in this country. Principal of these is the successful introduction of liquid chlorine for bleaching cotton textiles. Former bleaching methods weakened the cloth.

The flaking of alkalies was introduced with the flaking of caustic potash just prior to World War I, as a means of meeting German competition for this product, which then sold only in fused, broken and liquid forms. It was the first firm to produce potassium carbonate, while it also first supplied hydrogen from electrolytic cells, for use in making ammonia. It was one of the first to make monochlorobenzene and paradichlorobenzene. Most recent addition to the company's list of chemicals, while not new, is trichlorethylene of high stability, largely used in metal cleaning and degreasing.

Principal officers of Niagara Alkali, besides Mr. Cassidy, are *S. Willard Jacobs*, vice president, *Stephen J. White*, vice president and treasurer, and *William J. Weed*, manager of sales.

Mid-West Abrasives 1950 Sales 30% Above Last Year

A net income of $130,778.37, after provision for all taxes, for the six months ended June 30, 1950, is reported by *Mid-West Abrasive Company, Owosso, Mich.* The company's earnings are equal to 43 cents per share on 303,720 shares outstanding, compared with $60,913.69, or 20 cents per share, for the six months ended June 30, 1949.

James T. Jackson, Mid-West president and general manager, said the company's current assets on June 30, 1950, were $1,173,799, and current liabilities $407,887, a ratio of 2.87 to 1.

Mr. Jackson also reported Mid-west Abrasive Company's sales during the first half of 1950 increased 30% over sales for the first half of 1949. The June volume was the largest in the company's history.

Mid-West Abrasive Company manufactures a complete line of grinding wheels, sandpapers, hones, and sharpening stones. It operates three plants; two in Owosso, and a third in Rochester, Pa.

Swenson Promoted in Mech. Goods Div. of U. S. Rubber

Appointment of *Nils Walter Swenson* as assistant manager of branch sales for the mechanical goods division, *United States Rubber Co.*, was announced today by *W. A. Tipton*, branch sales manager.

Mr. Swenson was formerly manager of mechanical goods sales for the company's Buffalo, N. Y., branch. He will make his new headquarters at the company's New York offices in Rockefeller Center.

Products manufactured by the mechanical goods division include all types of belting, hose, packing, molded goods, grinding wheels, rubber linings, printers' materials and hundreds of miscellaneous products for industry made of both rubber and plastics.

Goebel New Technical Director of Grasselli, Div. of DuPont

Dr. Max T. Goebel, assistant technical director of the Du Pont Company's Grasselli Chemicals Department, has been appointed technical director, succeeding *Dr. John C. Woodhouse* who has undertaken a special assignment with the company.

A native of Compton, Ill., Dr. Goe-

bel atten-ed Carthage College, Ill., and received his A.B. and Ph.D. degrees in chemistry from the University of Illinois. He joined Du Pont in 1934 as a research chemist at the Experimental Station. In 1941 he was transferred to Cleveland as assistant manager, general research section of the Grasselli Chemicals Dept., becoming manager three years later. He was made assistant technical director of the department in 1948.

Atlas Mineral Makes Personnel Changes

Mr. George L. Wirtz, President of the *Atlas Mineral Products Co.,* Mertztown, Pa., has announced the following personnel appointments in keeping with a long range expansion program at Atlas.

Mr. Edison C. Sickman, formerly Baltimore District Sales Mgr., has been appointed General Sales Coordinator. Mr. Sickman received his B.A. degree at the University of Dayton and has done work at Wittenberg College, Indiana University and Antioch College. Prior to joining Atlas he worked in various phases of management and sales in the plating supplies and metal finishing fields.

Mr. Ray Russell Graver, has accepted a position in the Atlas Engineering Department. Mr. Graver recently received his B.S. degree in Chemistry at Muhlenberg College.

Mr. Gerald F. Gilbert, Jr., who recently received his B.S. degree in Chemical Engineering from Lehigh University, has accepted a position as assistant to the Technical Director effective July 10, 1950.

Mr. Richard A. Weppner has been appointed sales engineer for corrosion-resistant chemical construction materials in Delaware, Maryland, Virginia and parts of West Virginia and New Jersey. Mr. Weppner holds B.S. and M.S. degrees in Chemical Engineering from the University of Notre Dame and has had over 12 years experience in sales and consultation in corrosion-resistant materials, solvents, coatings, and plastics. Prior to joining Atlas he was a sales engineer on corrosion-resistant products for the Pennsylvania Salt Mfg. Co.

Mr. Philip E. Berens has been appointed sales representative for corrosion-resistant materials in Eastern Pennsylvania, Western New York and parts of New Jersey. Mr. Berens has served part of this territory for Atlas before and more recently has been located in the Detroit Territory. He received his B.A. degree in Chemistry from the University of Pennsylvania and prior to joining Atlas was General Manager of the Electro-Chemical Supply and Engineering Co.

Mr. William A. Streaker has been appointed sales engineer for corrosion-proof materials in the lower peninsula of Michigan, Eastern Indiana and Lucas County in Ohio. Mr. Streaker received his B.S. degrees in Chemical Engineering from the University of Illinois and prior to this appointment was in the Atlas Engineering Department. Before joining Atlas he was associated with the General Electric Co.

New Hooker-Detrex Trichlorethylene Plant

Completion of a large, modern trichlorethylene manufacturing plant at Ashtabula, Ohio has just been announced by *Hooker-Detrex, Inc.*

The full production capacity of the new plant will be utilized in the manufacture of Perm-A-Clor and Triad metal degreasing solvents for the *Detrex Corp.,* Detroit 32, Mich. The plant is located in one of the few areas in the United States where all raw materials are directly available through pipelines from adjacent plants. It has the advantage of being centrally located with respect to major industrial centers.

Because of the increasing demand for non-flammable degreasing solvents,

this additional capacity is most welcome at this time. The solvents produced are available for both industrial cleaning and oil-extraction processes.

The Works Manager of the Ashtabula plant is *H. D. McKinley*, formerly Manager of the Solvents Division of Detrex. Mr. McKinley also collaborated in the design, erection, and initial operation of the Hooker-Detrex solvent manufacturing plant at Tacoma, Washington three years ago. The manufacturing operations of both the Ashtabula and Tacoma plants are supervised by Hooker Electrochemical Co. The national distribution of the entire output of these plants is handled exclusively by Detrex Corporation.

Pennsalt Appoints F. E. Murphy Wyandotte Production Supervisor

Francis E. Murphy has been appointed production supervisor of the Wyandotte works of the Pennsylvania Salt Manufacturing Co. In this capacity, Mr. Murphy will be in active charge of all Pennsalt's chemical plant operations in Wyandotte and will report to *H. J. Eichenhofer*, assistant superintendent.

Mr. Murphy joined Pennsalt in 1943. A graduate of St. Joseph's College, Philadelphia, Mr. Murphy is a member of the American Chemical Society, the American Institute of Chemical Engineers and Franklin Institute of Philadelphia.

John Bogen, formerly with Pennsalt's production department in Philadelphia has been transferred to Wyandotte. Mr. Bogen is a graduate of the University of Michigan.

British Metal Finishing Specialist Team Visits H-VW-M Plant

A group of thirteen specialists from the British metal finishing industry,

studying their American counterpart industries, visited the *Hanson-Van Winkle-Munning Co.*, of Matawan, N. J. on August 24, 1950. The itinerary, arranged under the combined auspices of the Anglo-American Council on Productivity and the E.C.A., includes the study of technical and manufacturing processes in the electroplating and painting industries. The group is also interested in the industry's labor relations and practices as compared with those in similar British industries.

After being welcomed by *Louis M. Hague*, president of H-VW-M, the group spent the morning on a guided tour through the recently enlarged laboratory, the largest of its kind in the world. They were conducted by *Myron Diggin*, Technical Director, and *D. G. Foulke*, Chief Chemist, both of H-VW-

M. Here they saw a complete modern plating installation, up-to-date facilities for the analysis and control of electroplating solutions, and the most advanced equipment for research in the electroplating part of the metal finishing industry.

The afternoon was devoted to the manufacturing techniques of the business when the group toured the manufacturing plants of the company, escorted by *John Boots*, Personal Director, and member of the Factory Management Committee. Special attention was given to the study of manufacturing techniques in the building of low-voltage motor generators described by *Ross Lyons*, Manager of Electrical Sales, full-automatic plating equipment described by *Irving Gemmell*, Assistant Manager of Conveyor Sales, and the production of finishing supplies such as plating anodes, chemicals, buffs, polishing compositions, etc.

At the end of the day, when asked what impressed them most, the group was unanimous in expressing amazement in the amount of free service given by American industry to their customers in the way of laboratory and field service; also, the extent to which the plating industry goes in utilizing instrumentation and control equipment to insure the uniformity of plated deposits.

H-VW-M, because of its unusually complete line of equipment, materials, and processes, was the only manufacturer of plating equipment chosen to be visited by this visiting team of ex-

Group photo taken in front of new laboratory and administration building. Reading from left to right: Maurice Fry, Bernard Turner, Leslie Connell, Arthur Lines, Fred Willetts, Walter Ehrlinger (Export Mgr. H-VW-M), John Adcock, D. G. Foulke (Chief Chemist H-VW-M), George Woodall, Ernest Marsh, Louis M. Hague (President H-VW-M), Victor Long, Myron Diggin (Technical Director H-VM-M), Roy Hammond, Norman Watts, Frederick Champion, John Neubauer (President Local AFL Union), George Hogaboom (Consultant), John Boots (Personnel Director H-VW-M), Norman Tope, Julius Demeter, (ECA Project Manager).

perts. The balance of their itinerary will be focused on producers of finished plated and painted products.

The leader of the English team is *Mr. John Adcock.* Arrangements for H-VW-M were made by *Walter J. Ehrlinger*, Export Manager for the company.

Dow to Start Voluntary Allocation of Magnesium

The *Dow Chemical Co.* announced on Sept. 12th that a procedure for voluntary allocation of magnesium was being put into effect immediately.

This step is being taken to insure an adequate supply for military requirements which have increased since the start of the Korean situation, and to insure fair distribution to established commercial customers.

Rubinstein Engaged by Israeli Government

Mr. Marvin Rubinstein, metal finishing consultant of New York City, has been engaged by the government of Israeli to set up a complete aircraft finishing plant for the Israeli National Airlines at Tel-Aviv. Mr. Rubinstein assumed his new position on Sept. 10.

Carborundum Co. Makes Sales Appointments

Sales assignments announced recently by *The Carborundum Co.* include the appointment of *John A. Decker*, as Sales Manager for the New York District, and appointment of *William J. Kingsley* as Assistant Sales Manager of the Bonded Products and Grain Division, with headquarters in Niagara Falls, N. Y.

Mr. Decker, with the Company since 1933, held the position of Assistant Sales Manager of the New York District prior to his present appointment. Mr. Kingsley, a veteran of 28 years' service with Carborundum, was previously a salesman working out of Syracuse, N. Y. and Boston, Mass.

Other changes announced by the company provide for the transfer of *Thomas Curtiss*, a field sales representative in the Buffalo District, to the Central New York area. *Edgar T. Harris* will fill the Buffalo District Office vacancy resulting from the transfer of Mr. Curtiss. *George Dennison* was named a special Sales Engineering representative for the New York State, with headquarters in the Buffalo District Office. Mr. Dennison had been previously an industrial salesman in the Buffalo District.

Rapid Electric Moves to New Quarters

Rapid Electric Co. moved early in August to much larger quarters at *2881 Middletown Road, Bronx 61, N. Y.*, a plant specially designed and built for the manufacture of a complete line of selenium rectifiers and periodic reverse units. At the new location, three times as large as the old shop, expanded engineering and research departments will be installed, allowing the firm, which offers free consultation service to the trade, to study and solve a wider variety of production problems.

Expanded facilities will allow maintaining normal delivery schedules on a constantly increasing volume of business, an official stated.

3M Co. to Build in Atlanta, Ga.

Plans for the construction of two adjoining buildings for warehouse and sales office space in Atlanta, Ga., have been announced by the *Minnesota Mining & Manufacturing Co.*

According to *C. P. Pesek*, the 3M company's vice president in charge of engineering, both units are expected to be ready for occupancy about January 1.

The one-story structures will have a total floor area of 12,500 square feet. The warehouse building, larger of the two, will cover 10,000 square feet with outside dimensions of 100 by 100 feet.

The office building, measuring 41 by 61 feet, will contain about 2,500 square feet.

They will be located on Piedmont Road north of Metal Road, will be of steel and masonry construction, and will be served by the Seaboard Airline Railway, Pesek said.

Pennsalt Names Two Sales Managers in Heavy Chemicals Department

George D. Grogan and *Donald Macfarlan, Jr.*, have been appointed district sales managers in Chicago and Detroit, respectively, for the heavy chemicals department of the *Pennsylvania Salt Mfg. Co.*, it was announced by *R. S. Roeller*, manager of the department.

Mr. Grogan formerly was a product supervisor in the Philadelphia office and Mr. Macfarlan was a sales representative in the Paterson, N. J. office. *H. G. Potts*, formerly district sales manager in Detroit, has been named supervisor of technical service for the midwest areas. *H. A. Smith*, formerly district manager in Chicago, has been given special assignments in the heavy chemical field in the Chicago area.

L. H. Brandt, formerly manager of technical service, has been appointed product supervisor in the Philadelphia office. *A. C. Jones*, formerly Philadelphia district sales representative, and *Miss E. M. DeHaas*, have been appointed assistant product supervisors.

C. M. Fehr and *V. C. Lane*, sales engineers, have been assigned all technical service work in the Philadelphia, Paterson, Pittsburgh and Cincinnati districts. *H. R. Bishop*, formerly sales representative in Chicago, has been transferred to fill a similar post in the Paterson office.

Pretty Pilot Picks up Pump with Plater's Private Plane

Quick transportation for urgently needed small parts and machinery supplies are becoming as slight a problem to many business men as to the mother who says, "Johnnie, hop on your bike and run down to the store for me." Only in this case it wasn't a bike, it was a plane—and it wasn't Johnnie, it was Rose.

Miss Rose Van der Horst, petite pigtailed blond from Hilversum, Holland, is the daughter of *Mr. H. Van der Horst*, president of *Van der Horst Corp.* in Olean, N. Y. She has been piloting in this country for three years, with a total of more than 500 flying hours, and is a member of Aircraft Owners & Pilot Association.

Miss Rose Van der Horst, attractive Olean pilot, of Portville, N. Y., receives chemical pump at Newark Airport from Fred Waite, Sales Engineer, Worthington Pump and Machinery Corp.

One Thursday, Mr. Van der Horst decided he needed a pump for experimental plating solutions. "Rose—hop down to Newark Airport and pick up the pump." Friday the pump was installed and running at Olean.

Mid-West Abrasive Annual Report Wins Award

Financial World Magazine has awarded an honorable mention citation to *Mid-West Abrasive*, Owosso, Mich., for the company's annual report for 1949.

While notifying *James T. Jackson*, Mid-West president and general manager, of the award, *Weston Smith*, ex-

ecutive vice-president of the magazine, said the Mid-West 1949 report showed marked improvement in content, format, and typography since 1940. The publication's survey covered approximately 2,500 annual reports issued by companies throughout the United States.

Aluminum Sheet and Plate Nomenclature Approved

To clarify the designation of aluminum sheet and plate, the Sheet Division of *The Aluminum Association* has adopted standard nomenclature for these products, *Donald M. White*, secretary of The Association has announced.

The following definitions were adopted:

(1) *Plate* is a solid section rolled to a thickness of 0.250 inch and heavier, in rectangular form with either sheared or sawed edges.

(2) *Sheet* is a solid section rolled to a thickness range of 0.006 inch to 0.249 inch inclusive, supplied with sheared, slit, or sawed edges.

a. *Flat Sheet* is furnished in rectangular form with sheared, slit, or sawed edges, which may be flattened by any standard method.

b. *Coiled Sheet* is furnished in rolls (coils) with slit edges.

Heretofore, the terms "strip" and "coiled sheet" were applied interchangeably to the same product, but the new nomenclature officially recognizes the latter, more descriptive term.

The definitions were formulated by the Sheet Division of the Association which consists of the Aluminum Company of America, Pittsburgh, Pa., Sheet Aluminum Corp., Jackson, Mich., Kaiser Aluminum and Chemical Corp., Oakland, Calif., Reynolds Metals Co., Louisville, Ky., Revere Copper and Brass, Inc., Baltimore, Md., Alum. Co., Fairmont, W. Va., and United Smelting and Alum. Co., New Haven, Conn.

Walker New Chief Chemist for Michigan Abrasive Co.

M. O. Walker, formerly process engineer with the Coated Products Div. of the Carborundum Company, has been named chief chemist of the *Michigan Abrasive Co.*, according to *Max C. Jones*, President.

Mr. Walker is a graduate of the University of Buffalo and is the holder of the Legion of Merit Award granted him because of his services in the North African campaign of the recent World War. Mr. Walker is married and the father of two children. He is a member of the American Chemical Society.

His addition to the staff is a major factor in the development of coated abrasives research and techniques at the Michigan Abrasive Company, according to Jones.

Manhattan Rubber Names P. L. Edwards Central District Manager

Appointment of *P. L. Edwards* as manager of its Central District Office in Pittsburgh, has been announced by *Raybestos-Manhattan, Inc., Manhattan Rubber Division, Passaic, N. J.* He succeeds *R. C. Rice*, who retires from active service with the company. Mr. Edwards has a long background of experience and accomplishment in the sale of industrial rubber products and, during recent years, has served as assistant to Mr. Rice. He assumed his new duties on September 1.

O'Donohue Sales Co. Moves to New Quarters

After Sept. 1, 1950 the offices of the *O'Donohue Sales Corp.*, distributors of plating equipment and supplies, will be located at 2326-28 West State St., Milwaukee 3, Wis.

Manufacturers' Literature

Plating Rack Cataloque

National Rack Co., Dept. MF, 396 River St., Paterson, N. J.

Because of the interest shown in their wide and extensive facilities, National Rack Co., and Imperial Plating Rack Company have a new pictorial catalog.

This catalog illustrates their plants which together make them one of the largest rack manufacturers in the United States, devoting their entire facilities to plating rack manufacturing.

Mr. Faulman, president of both companies, shows in this 12 page catalog technical facilities with which they are serving their customers. From their Engineering Department to their specialized sample Rack Department, "Naraco" produces a scientific rack designed to do a specific job—in rack sizes of one foot to 112 inches long.

Also illustrated in this catalog are the unique replacement tip assembly, and their 100% solids brown insulation.

Calculators for Electroplating

F. J. Morrow, Dept. MF, 288 Montgomery St., Bloomfield, N. J.

This firm has announced the availability of two circular style calculating devices for computing plating times, thicknesses, total weight of plated metal, and other figures of importance in estimating prices and plating schedules. Surface areas, total amperes, plating time, bath efficiency for various thicknesses of all platable metals is correlated. Both of the calculators are reasonably priced. The firm also plans to market a smaller sized unit that can be carried in a vest pocket. The size of the present computers is $5\frac{1}{4}$" x $7\frac{3}{4}$".

Polyethylene

Bakelite Div., Union Carbide & Carbon Co., Dept. MF, 300 Madison Ave., N. Y. 17, N. Y.

This firm has just published a booklet showing the wide range of applications for polyethylene which depend on its unique combination of properties such as chemical inertness, nontoxicity, and lack of odor and taste. Ease of fabrication, toughness over wide temperature ranges, and low water absorption are among the reasons why this plastic material has gained such wide popularity in the chemical and corrosion-resisting field. Copies of the book are available on request.

Automatic Burnishing Machine

Lupomatic Industries, Inc., Dept. MF, 4510 Bullard Ave., New York 66, N. Y.

A new development in equipment for wet ball burnishing and polishing, the completely automatic Tumb-L-Dur burnishing machine, is described in a new bulletin issued by the above firm.

Most important feature of this new machine is the molded Tumb-L-Dur barrel, made from an exclusive material that is claimed to be revolutionary in its advantages. This barrel is said to have an exceptionally long life. The same rugged service that can wear out a wood barrel in $3\frac{1}{2}$ to 4 weeks has not affected a Tumb-L-Dur barrel in use for more than $1\frac{1}{2}$ years, according to this firm. Another important advantage discussed in the new bulletin is Tumb-L-Dur's ability to resist warping. Barrels made of this material may be kept out of water when not in use, without damage. Because of Tumb-L-Dur's extra strength, thinner barrel walls can be used, resulting in increased capacity.

The bulletin contains complete specifications for Tumb-L-Matic's standard UP line, which may also be equipped with fabricated Tumb-L-Dur barrels. Model numbers, tumbler sizes, and capacities are given.

A copy of this new bulletin—No. TDB-50—may be obtained by writing.

Fingerprint Remover & Rust Preventive

Nox-Rust Chem. Corp., Dept. MF, 2423 S. Halsted St., Chicago 8, Ill.

Protection against rust for metal parts during manufacturing, in storage and in transit, is discussed in a new four-page bulletin recently offered by this firm. The bulletin covers the company's Nox-Rust 310-AC which removes fingerprints and deposits a thin, transparent film. Application is made by brushing, spraying, or dipping at room temperatures. The free bulletin is available from the manufacturer.

Hydro-Clone Dust Collectors

Whiting Corp., Dept. MF, Harvey, Ill.

Two new bulletins on Hydro-Clone dust suppression have been published by this firm.

These bulletins are (a) Hydro-Clone Sludge Tanks (Bulletin FY-166) which describes the function and gives the dimensions for both manual and automatic sludge settling tanks, and (b) Hydro-Clone Installations (Bulletin FY-167) which shows a variety of installations of Hydro-Clones operating under typical conditions.

Whiting Hydro-Clones are based on the theory that wetting is true suppression. In Hydro-Clones, thorough wetting reduces all dust particles to easily disposable sludge.

These two new bulletins are the most recently published in a series of interesting pamphlets on dust suppression. Either or both of these new bulletins will be sent, upon request, to all interested persons.

Dust Arrester Bulletin

American Air Filter Co., Dept. MF, Louisville, Ky.

This bulletin is a revision of Airmat Dust Arrester Bulletin 280A.

The new bulletin features the following revised and improved construction items:

1. All units are provided with a fixed spacer between pockets to provide better sealing between dust laden and the clean air side of the arrester. Pocket covers on the No. 7 units are now hinged at the top of the pocket similar to the construction of the No. 50 unit.
2. Panel construction of the Airmat Dustbox housing is now employed to faciliate faster shipment of Airmat Dustboxes. This construction can involve some minor changes as will be noted from dimensions on page 7.
3. Head room above the pockets necessary for pocket removal on the No. 7 and No. 13 units becomes 36" rather than 30" in the earlier design. Recommended minimum head room of 30" has been unchanged for the No. 50 Airmat Units.

Industrial Water Engineering

Hall Laboratories, Dept. MF, Hagan Bldg., Pittsburgh, Pa.

Industrial water problems of all kinds—procurement, treatment, usage and disposal—and the facilities and services offered in coping with them are described and charted in a new booklet just published by this firm of water consultants.

Various kinds of industrial water problems, and their solution, are described in the booklet, which is en-

titled "Y[illegible]r Most Important Raw Material." C[illegible]pies are available upon request.

Uses for Chromic Acid in Metal Finishing

Fiber Chemical Co., Dept. MF, P.O. Box 218, Matawan, N. J.

The above firm has just published an extensive bibliography on the use of chromic acid in various metal finishing operations, such as chrome plating, anodizing, electropolishing, pickling, etching, stripping, etc. Copies of these reports are available without charge.

Wear Testing Machine

Taber Instrument Corp., Dept. MF, 111-MEF Goudry St., North Tonawanda, N. Y.

Recently issued by the above firm is a new bulletin describing their Abraser Wear Tester and accessories, Model 140. It gives step-by-step procedure for operating a test, and pictures and describes the various parts of the equipment for testing a wide range of materials from metallic coatings to fabrics. A list of prominent users of the equipment is also given. Copies of Bulletin #5003 may be obtained on request.

Stainless Steel Valves, Fittings, and Accessories

Cooper Alloy Foundry Co., Dept. MF, Hillsdale 5, N. J.

This firm announces publication of their new stainless steel valve, fitting and accessory catalog. Complete in every detail, this attractive 48 page catalog contains engineering drawings, weights, dimensions, size ranges, materials, corrosion data, nomenclature and design information woven into an easy-to-read and easy-to-follow booklet.

The complete line of Cooper Alloy stainless steel, nickel and monel gate, globe, angle, needle, Y, check, tank and other valves; screwed, flanged, welding and forged fittings; flanges, gauges, pet and plug cocks, hose fittings and other accessories, is illustrated and discussed. Copies are available on request.

Rubber Floor Matting

B. F. Goodrich Co., Dept. MF, Akron, O.

Three new catalog sections on its

lines of matting have been published by the above firm. Copies are now available upon request.

Corrosion Prevention With Metallizing

Metallizing Engineering Co., Inc., Dept. MF, 38-14 30th St., Long Island City 1, N. Y.

In a new bulletin the above firm announces the new METCO systems for corrosion prevention. This new technique prevents rust on tanks, bridges, piling, ship and boat hulls, refrigeration equipment and fabricated steel products for 25-50 or 100 years, it is claimed.

The Metco systems provide pure zinc or aluminum coatings properly treated to withstand various corrosive conditions. The pure zinc or aluminum is applied directly to the steel base with standard metallizing equipment. In most systems the zinc or aluminum is then given a specific organic treatment depending on the service requirements.

Bulletin 93 briefly describes the Metco systems and their uses and applications. Send for your copy.

News from California

Two former employees of the *L. H. Butcher Company's* Los Angeles plant occupy executive positions in the *Alert Supply Co.*, a new firm recently established at 6718 McKinley Avenue, Los Angeles, for the manufacture of buffing and polishing compounds.

A. E. Perkins, formerly a member of the Butcher Company's plating supply division sales staff, is president; *Kim W. Jung*, formerly of the L.H.B. laboratory research staff, is director of production; and *A. K. Kaskin* is secretary-treasurer.

Consolidation of three well-known firms in the West Coast metals industry field has been announced. Involved in the merger are *Adel Precision Products Corp.*, Burbank; *General Metals Corp.*, Los Angeles, Oakland, and Houston, Tex.; and *Enterprise Engine & Foundry Co.* of San Francisco. Adel has been named the Adel Div. of General Metals; Enterprise Engine & Foundry is now operated as the Enterprise Division; and the three plants of General are to be operated as the Metals Division.

New metal finishing and production facilities, a new metal die works building and a new cabinet plant are included in the plans for an $800,000 expansion program announced for the *Packard-Bell Co.*, Los Angeles radio and television set manufacturers. Construction on the new buildings was expected to start in August and is expected to increase production facilities by 50 per cent.

Turco Products, Inc., of Los Angeles, manufacturers of industrial cleaning compounds, has announced two staff changes. *J. D. Charters*, district sales manager of the Houston, Tex., division, has been transferred to the Northern California sales district, with headquarters in San Francisco, where he succeeded the late *Al Martinez*. *Chris Williams*, formerly assistant district manager at Houston, has been promoted to district manager in that area.

Thirty-four lawsuits asking damages

of nearly $3,500,000 for the deaths of 15 persons and injuries to others in the terrific explosion on February 20, 1947, of the *O'Connor Plating Co.* on East Pico Blvd., Los Angeles, were consolidated for trial which opened in the Los Angeles Superior Court on July 28. A score of attorneys who represented the various plaintiffs and the defendants stipulated that Superior Judge Henry M. Willis should hear the joint cases without a jury. First matter considered was that of liability, with each case to be studied as to the amount of damages to be rendered in the event liability was established.

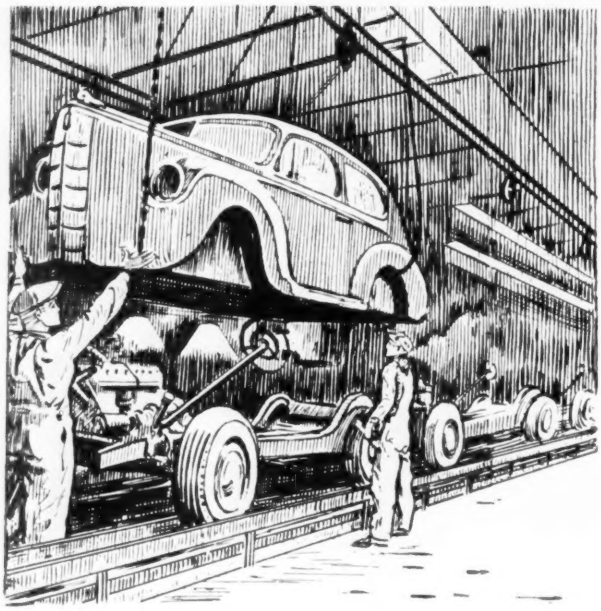
The plant at 922 East Pico Boulevard literally dissolved in a flaming blast that razed a square block around it. Among the dead were employees, neighbors, and a 9-year-old boy who was riding his bicycle on the sidewalk nearby. The explosion started in an electropolishing bath being operated by the firm.

Named defendants in the suit were *J. J. O'Connor, Robert J. O'Connor* and *Lillian O'Connor.* (See March, 1947, issue of *Metal Finishing* for complete report of the O'Connor plating plant catastrophy.)

Modern aluminum finishing facilities are included in plans for a new $300,000 plant for the *Kool Vent of California* concern on which construction was recently initiated at the Los Angeles Airport. Claimed to be the largest metal awning factory in the country, the new plant will have 56,000 square feet devoted to the manufacture of aluminum awnings.

Robertshaw-Fulton Controls Co. has announced the appointment of *Orlo E. Brown, Jr.*, as research metallurgist at its Southern California plant. Mr. Brown had previously served as chief metallurgist for Western Gear Works in Los Angeles. His extra-curricular activity includes service on the extension faculty of the University of California at Los Angeles as an instructor of metallurgy.

Marine Metal Spinning & Mfg. Co., in early August completed removal from 628 South Clarence Street into a new and larger plant at 5020 West Jefferson Blvd., Los Angeles. The firm does metal spinning for the lighting fixture industry and also general metal spinning work.



MOTOR CITY PLATING NEWS

by

Edward Finne

A shortage of supplies is besetting the platers of Detroit. Nickel and copper have been hard to obtain because of allocation and the chromic acid supply is tightening up because of strikes in some alkali plants. Soda ash is practically impossible to buy.

And now, in the first week of September, *Wyandotte Chemical Company's* three plants in Wyandotte have been shut down by strikes. This has cut off a majority of the cleaner supplies to platers. To further cloud the picture, *Pennsalt* is rumored to be next closed by strikers.

So the plating industry in Detroit is faced with a virtual shutdown of facilities because of lack of vital supplies. Unless the situation changes, we are in for a bad time.

Incidently, the strike against Wyandotte is the first in 33 years.

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Resourcefulness and a willingness to pay a price has obtained 10,000 pounds of scarce nickel for General Motors.

Generalissimo Chiang Kai-shek and his Nationalist government had a large store of Chinese coins which were minted from pure nickel. They cost the Chinese roughly 80 cents a pound. Some broker in Formosa, learning of the nickel shortage here, offered to pay $1.00 a pound for the stored coins. They were then sold to a West Coast broker for $1.20 a pound. General Motors bought 10,000 pounds at $1.45 a pound and remelted them into nickel anodes. The cost was more than double the market price for nickel, but at least GM has obtained some needed plating metal in an interesting transaction.

****

M. R. Robertson has joined Lyon, Inc., 13881 W. Chicago Blvd., Detroit as compound chemist. He will work on development of buffing compounds. Robertson previously was with F. B. Stevens, Inc., in the same capacity.

****

Francis E. Murphy has been appointed production supervisor of the Wyandotte works of Pennsylvania Salt Mfg. Co. Murphy will leave control duties at Pennsalt's production department in Philadelphia to take up active charge of all chemical operations at Wyandotte.

****

George H. Baker has been appointed head of a newly formed employe and public relations division at Wyandotte Chemicals Corp. He comes from American Potash and Chemical Corp. where he performed in a similar capacity.

****

Buck M. Rogers is now salesman for Nicholl Hard Chrome Service, 9350 Grinnell, Detroit 13. Rogers formerly sold for DeLuxe Hard Chrome in Detroit.

****

Carl Heussner of the Chrysler Corporation, chairman of the Detroit A.E.S. Branch's annual Christmas party, has tickets for sale for this event. Those of you who have attended Detroit's yearly technical session and dinner party know what a good time you will have. Tickets at $7.50 can be obtained from Carl by writing to him at 552 Brookside Drive, Birmingham, Mich.

****

The first meeting of the 1950-51 season of Detroit's A.E.S. branch was held at the Statler Hotel on Sept. 8th with approximately 175 members at-

tending. *Frank Clifton*, 1st Vice-President presided in place of the absent president, *Ed Hahn*.

Thirteen new applicants for membership were voted on and accepted. Two applicants were from foreign countries—one from England and one from Windsor, Canada.

Ed Schroeder, sales manager, Electric Products Co. gave a lengthy talk on *"Plating Power Supply—Its Application and Usage."* His talk covered proper application of generators and rectifiers. Also covered was the Homopolar generator.

Liquid refreshments wound up the evening.

Associations and Societies

AMERICAN SOCIETY FOR METALS

National Metal Show to Be Held in Chicago on Oct. 23-27

The 32nd annual National Metal Congress and Exposition, more commonly known as the "Metal Show" will be held at the International Amphitheater in Chicago on Oct. 23-24-25-26-27, 1950. Technical meetings will be held at the Hotels Palmer House, Sherman, Sheraton, and Morrison. This annual affair, sponsored and arranged by the American Society for Metals, in conjunction with several other technical societies in the metals field, will have as its theme "Materials and Equipment for High Production."

Approximately 350 firms will have exhibits in the Amphitheater, with attendants who can answer all types of questions regarding the application of their products to individual production problems.

Special events scheduled, in addition to the technical program, are:

A.S.M. Business Forum

A meeting of officials in all branches of the metal-working industries to discuss present problems and future prospects.

Sales Clinic

Panel discussions on marketing and sales problems.

Industrial Motion Pictures

An opportunity for industries to show their pictures and explain the application to production problems of the products shown.

A number of firms in the metal finishing field will have exhibits. These are listed below, with the booth numbers and list of executives who will be in attendance.

Booth

Acme Mfg. Co. 218
1645 Howard St., Detroit, Mich.
Semi-automatic, rotary, and straight line automatic polishing and buffing machines.
Geo. R. Carlson, Glen A. Carlson, Arthur Losey.

G. S. Blakeslee & Co. ....
1844 52nd Ave., Chicago, Ill.
Vapor degreasing Equipment.

Circo Products Co. ....
6531 Euclid Ave., Cleveland, O.
Vapor degreasing machines.

Delta Mfg. Co. 2701
600 E. Vienna Ave., Milwaukee, Wis.
Belt grinding equipment.
Mr. B. Eldridge and others.

Detrex Corp. 2222
Box 501 Roosevelt Park Annex, Detroit 32, Mich.
Vapor degreasing equipment with rotary

internal conveyor; Rotary drum washers. Rust proofing and cleaning compounds.
E. H. Ehlert, L. Camel, W. F. Newberry, G. W. Walter, W. A. Nismer, P. M. Schultz, V. A. Monaco.

Diversey Corp. **619**
1820 Roscoe St., Chicago, Ill.
Cleaning compounds for metal surfaces.
R. L. Shannon, D. F. Seymour, L. C. Hesoun, A. J. Wurster, E. F. Manning, W. H. Murphy, W. R. Swift, A. A. Westfall, C. G. Smith, L. J. Moyes.

E. I. duPont de Nemours Co. **1602**
Wilmington, Del.
Vapor degreasing and Sodium Hydride descaling.
P. R. Hendrixson, C. B. Shepherd, A. P. Statser, H. L. Alexander, H. L. Benner, G. L. Dorough, F. J. Holt, W. R. Huey.

Eclipse Fuel Engineering Co. **927**
711 S. Main St., Rockford, Ill.
Gas burners and combustion equipment for heating tanks, solutions, etc.

Handy and Harman **1606**
82 Fulton St. N. Y., N. Y.

E. F. Houghton Co. ....
303 W. Lehigh St., Phila., Pa.
Blackening salts, rust preventives.

International Nickel Co. **1107**
67 Wall St., N. Y., N. Y.
Nickel anodes and salts. Platinum metals.

Kold-Hold Mfg. Co. **2208**
Lansing 4, Mich.
Platecoil heating coils for plating tanks and cleaning baths.

L. S. Worthington, C. P. Yoder, J. R. Tranter, J. R. Tepfer, W. P. Nevins, C. L. Carlson, L. E. Hammond, E. J. Nevins, F. L. Winkler, W. H. Worth.

Oakite Products Co. **322**
22 Thames St., N. Y., N. Y.
Cleaning and surface preparation chemicals, pre-paint treatments, pickling agents, inhibitors, etc.
Frank J. McNally and others.

Osborn Mfg. Co. **319**
5401 Hamilton Ave., Cleveland, O.
Power brushes for industrial cleaning and surface preparation. Gear de-burring methods.
A. V. Parnall, F. T. Turner, G. R. Lundberg, R. O. Peterson, R. R. Schultz, V. K. Charvat, R. C. Sasena, R. A. Barta, A. J. Chandler, R. G. Smellie, R. Lincoln, E. Richards, J. R. Broughan, S. C. Foxall, W. C. LaBerge, L. H. Ross.

Phillips Mfg. Co. ....
3483 W. Touhy Ave., Chicago, Ill.
Degreasing machines and solvents.

Raybestos-Manhattan, Inc. **2130**
Passaic, N. J.
W. H. Steinberg, L. S. Hilton, F. E. Tieman, H. Ahlers, C. M. Fleming, D. L. Cilley, E. E. Marlowe, A. Watchorn, E. G. Wilk, O. G. Harris.

Rolock, Inc. **522**
Fairfield, Conn.
Heat and corrosion resistant handling equipment; racks, boxes, fixtures, baskets.
S. G. Kroto, E. A. Terwell, W. F. Kinney, W. H. Martin, C. H. Weber, Jr.

Torit Mfg. Co. ....
289 Walnut St., St. Paul, Minn.
Dust collecting equipment.

Udylite Corp. **907**
Detroit 11, Mich.
Automatic transfer equipment for conveyorized finishing lines. Full automatic plating machines.

AMERICAN ELECTROPLATERS' SOCIETY

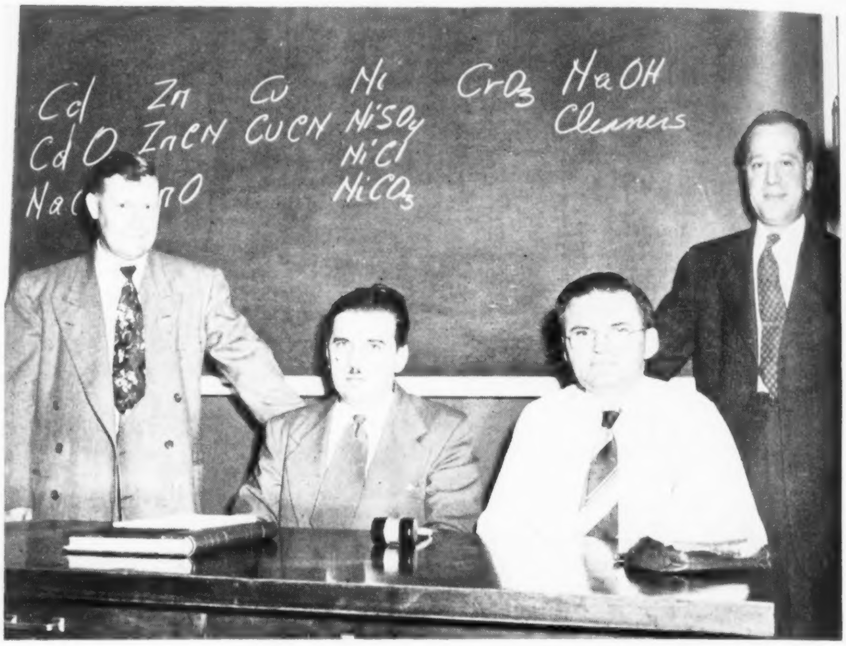
New York Branch

The New York Branch of the A.E.S. held their August meeting on Friday, Aug. 25, when they heard a talk by *Adolph Bregman*, consultant of New York City, on the effect of the war to date on the plating industry. Mr. Bregman traced the causes for the various shortages of chemicals and metals, and gave some information on what was being done or could be done about relieving the situation.

A short business meeting was held.

Scene at the Bull session after the meeting. From the attentive look on everyone's face the political speech on the wire recorder must have been absorbing.

CHICAGO ELECTROPLATERS HEAR MATTACOTTI ON METALS CONSERVATION



Vincent Mattacotti (right), Executive Manager of Milwaukee Plating Company, Milwaukee, Wis., addressed Chicago Branch, American Electroplaters Society at August Meeting. Others in photo are (left to right): J. M. Andrus, Librarian, Paul Glab (Northwestern Plating Company), Secretary-Treasurer, and Dr. J. H. Monaweck, President, Chicago Branch. A.E.S. members and guests from the Chicago Electro-Platers Institute also heard "Chalk Talk" by Larry George, Udylite Company.

in which five new members were elected.

A notable feature of this meeting was the presence of the entire team of metal finishing experts from England, who are touring the United States at the invitation of the Economic Co-operation Administration. After the conclusion of the formal part of the meeting, branch members held an informal discussion and social period lasting for several hours, during which the visitors asked numerous questions and told of conditions in the industry in England.

Obituary

EDWARD L. GANN

Edward L. Gann, a representative of the Hanson-Van Winkle-Munning Co. for many years, and a pioneer in The Technical Service field, passed away on June 30th at the age of 58.

Eddie was one of the best known and respected plating trouble shooters in the country, and his extremely wide practical knowledge of plating and its problems was always cheerfully shared with those in need of assistance. With no formal schooling beyond first grade high school, Eddie learned plating in the "school of hard knocks" by diligently studying every phase of plating operations and applying sound judgment and common sense to overcome difficulties. He had been with H-VW-M for over 40 years, principally in service work, and had travelled all over the U. S. in carrying out his duties. In addition to his professional competence, Eddie was a well-known athlete in his younger days, having played semi-pro baseball, football, and basketball, as well as boxing professionally under the name of "Spider Manley". He will be sorely missed by the host of friends who admired and respected his knowledge and friendship.

He is survived by three daughters and a son, Eddie Gann, Jr.

Technical Literature

Front Surface Mirrors

"Front surface mirrors" with aluminum reflecting surfaces are recommended for maximum or precise reflectivity in a report now available from the *Office of Technical Services* of the *U. S. Department of Commerce.*

The report, a summary of studies by the Army Engineer Research and Development Laboratories, indicates that a silicon monoxide film provides superior protection against abrasion, corrosion and thermal shock without causing significant loss of mirror reflectivity in the visible or infrared spectrum. Magnesium fluoride protection was found considerably more susceptible to corrosion.

Evaporated aluminum was found more suitable as a reflecting surface than silver because of finer grain, smoother surface, and good adherance to the mirror base.

The front surface mirror, which, like conventional mirrors, has a glass base, overcomes the loss of reflecting power and the tendency toward dual reflections noticed when the reflecting surface is placed behind the glass. In optical equipment, for example, back-surface mirrors have definite drawbacks. In outdoor use, however, the front surface mirror must be protectively coated.

PB 92821, *Silicon Monoxide Front Surface Mirrors*, 30 pages including photographs, drawings, graphs and tables, sells for 75 cents per copy. Orders should be addressed to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., accompanied by check or

money order payable to the Treasurer of the United States.

An additional more recent Engineer Research and Development laboratory report deals with *Preparation of Hard Oxide Films on Aluminum Surfaces and Applications of Such Films* (34 pages including drawings, photos, graphs and tables—$2.25 in microfilm, $5 in photostat). Orders for this report should be addressed to the Library of Congress, Photoduplication Service, Publication Board Project, Washington 25, D. C., accompanied by check or money order payable to the Librarian of Congress.

Reports on Expired Patents

Patent Publications, Dept. MF, P.O. Box #4094, Washington 15, D. C.

The first of a series of reports listing expired patents in certain fields of wide technical interest is announced by this firm with the recent release of a special grouping of 206 Official Patent Abstracts on the subject of Detergents.

All patents are issued so as to afford protection for the inventor for a period of 17 years. At the expiration of that period the patent becomes public property unless it has been officially re-issued. The special study on Detergents just released lists patents on that subject dated from November 19, 1929 through May 30, 1933; thus, all have exceeded the 17-year validity period.

The booklet on Detergents contains a total of 206 Patent Abstracts divided as follows: Toilet Soaps, Household and Heavy Duty Cleaners, 54; Metal Cleaning, Pickling and Descaling, 73; Paint, Varnish and Finish Removers, 25; Textile Detergents and Cleaners, 14, and, Miscellaneous, 40. The booklet contains a subject index.

Technical people and technical librarians, patent attorneys, etc., will find this special study of Detergents to be of interest in view of the wide range of products covered by the 206 abstracts and the current expansion in this important field. With this Detergent study readily at hand a considerable amount of labor, expense and time may be saved by researchers in that field. Price of the special Detergent Report No. 1 is $2.

NEW BOOKS

Atomic Attack—A Manual for Survival

Published by J. L. Balderston & G. W. Hewes, Dist. by Culver Products Co., 3831 Eastlawn Dr., Culver City, Calif. Price $1.00. 84 p. with illustrations.

"Defense against the atomic bomb is not hopeless. It is only more complicated than defense against the old-fashioned TNT and fire bombs. You must act more quickly. But if you know what to expect, what to do, you may come through unharmed even while your neighbors die. If, that is, you think fast in that split second when your life is at stake.

When an atomic bomb strikes there will be disaster; there will be destruction; there will be death. You need not die. Think — plan — now, and increase your chance of survival. It is possible to protect at lease one room in your home against the effects of

the Bomb. It is possible to guard against lethal radiation."

The foregoing is taken from the Introduction. This book is a practical manual for Civil Defense organizations, and others connected with disaster committees. It is also a "What To Do Book" for the individual.

The authors are *John L. Balderston, Jr.*, and *Gordon W. Hewes*. Balderston was Physicist-Engineer at Oak Ridge, Tenn., 1943-47; Assistant-Director, Association of Scientists for Atomic Education, 1947-48, and presently, Radioisotope Research Consultant, Los Angeles, Calif. Hewes was Analyzer of Japanese target cities for the 20th Air Force, World War II, and presently with the University of Southern California.

This Manual for Survival is released for publication and sponsored by the Council on Atomic Implications, at the University of Southern California.

Indium

By M. T. Ludwick. Published by the Indium Corp. of America, 60 E. 42 St., N. Y. C. 276 pages, 6" x 9". Price $7.50.

This is essentially a very complete bibliography of the literature on Indium, its extraction, uses, properties. It also includes a section on indium plating, comparing the various types of baths available with regard to throwing power, quality of plate, ease of analysis, cathode and anode efficiencies, etc. The baths listed include the cyanide, sulfamate, sulfate, and fluoborate types. Complete physical property charts and constitutional diagrams for all the indium alloys are given. The bulk of the book, (200 pages) is devoted to bibliography dating back to 1863.

The Condensed Chemical Dictionary

Published by Reinhold Pub. Co., 330 W. 42 St., N. Y. C. Price $10.00. 720 pages, 6" x 9".

The fourth edition of this book, completely revised and brought up to date, now contains over 23,000 items, including the new chemicals introduced during the past few years. Under each chemical is listed such information as properties, physical constants, derivation, grades available commercially, types of containers, principle uses, shipping regulations, etc. Trade names also refer to the manufacturers. This is a practical book for busy men who need quick condensed information on the many industrial chemicals now available.

Prevention of Deterioration Abstracts

Published by National Research Council, Rm. 204, 2101 Constitution Ave., Washington 25, D.C.

Offered for subscription on a yearly basis. Abstracts are classified under the headings: Biological agents; Electrical and electronic equipment; Fungicides and other toxic compounds; lacquers, paints, and varnishes; leather; lubricants; metals; miscellaneous; optical instruments and photographic equipment; packaging and storage; plastics, resins, rubbers, and waxes; textiles and cordage; and wood and paper. One volume of approximately 2,000 looseleaf pages is published each year in monthly issues. Subject and author indexes are compiled annually to cover abstracts issued from July through June. The yearly rate of

$50.00 includes two sturdy binders and index tabs.

An ADVANCE LIST, a monthly bibliography of all reports received in this field, is available for $10.00 a year.

PRACTICAL ELECTROPOLISHING

(*Concluded from page* 62)

equipping the tank is less than with lead, (2) the tank can be operated at lower voltage, and (3) the stainless steel requires little cleaning and/or no repairs.

Racks are a special problem because of the high current usage.

Copper is passivated by the electropolishing current in the stainless steel bath, so bare racks can be used with fairly long spline life. The electrical contact between the rack and the work must be such that overheating does not occur to burn the work at the point of contact. Bare rack points have a limited life at the contact area. Coating of contact points with speculum metal (plated) or with tin proves very effective for increasing the length of life. However, speculum metal and tin do not passivate completely, so the area employed increases the current required for the operation. The ideal set-up in this case would be a coated rack in which the bare contact area would be speculum plated. As the speculum wore off, it could be replated and the rack placed back into operation at low cost. Speculum coating should not be greater than .002" since thicker deposits tend to crack and peel when the spring is flexed.

Another possibility is the use of tantalum contact points. However, the cost of this material is so high that the part must be run in production for a long period of time to make it feasible. Also, care must be used by the operators so that the tip is not damaged by handling.

Figures 4 and 5 are photographs of the two (2) 700 gallon units used to process 3,000 square feet of work per day. The size of the parts was such that about 20,000 pieces were produced per day on a 3-shift basis. Figure 6 is a photograph of photograph of electropolished production parts.

The author wishes to acknowledge his appreciation to *Dr. C. L. Faust* for his helpful suggestions during the preparation of this article, and to the executives of *The Electric Auto-Lite Co.* who have made it possible to publish this material.

THE SAGA OF METAL FINISHING

A 1 Act Play

At the 25th Annual Meeting of the Electrodepositors Technical Society (London, England) held early this year there was presented a skit which portrays in an amusing manner the various personalities involved in the metal finishing field. We present it herewith through the courtesy of that Society, simply to show that the problems of metal finishing are the same throughout the world.

The Polisher

I'm black as Ethiope; strong and
tough.
My piece work's never high enough.
From dawn of day to dark of night
I polish metals mirror bright.
With mop and compo'—bob and grain
I smooth away each scratch and stain.
And when it's finished on my mop
I send it to the plating shop.

What happens there I grieve to tell,
Though every plater knows full well.
It's pickled, cleaned and acid dipped
Bright nickelled, chromed, rejected!
STRIPPED!

Thus is ended all my art,
And marred the lustre I impart.
Why should I labour, strive and toil
On work for plating fools to spoil?

Remember ere I leave this show,
My piece work price is still too low.

The Plater

I work all day in steamy gloom,
Toxic spray and poison fume,
Spoiling fag and tainting food,
Poorly paid,—misunderstood.
But yet I'm master of an art
Where every science plays its part
And only I can implement
The trend of new development.

No mediaval alchemists
E'er had such potent catalysts
As cobalt and formaldehyde,
Ketone and sulphamide,
Wetting agents—anti-pits,
All to give me their benefits.

No other trade in industry
Demands so wide a mastery
Of chemical constituents,
Of complicated instruments,
Of cathode bar and anode bag,
Plating jig and pumice rag,
Of vats of trichlorethylene,
Nickel, chrome, or stannate tin,
Silver, cadmium, brass or zinc,
Rochelle copper—salmon pink.

Yes—I'm proud when I create
Lustrous chrome or silver plate.

The Chemist

Here you see a nervous wreck,
At everybody's call and beck,
Condemned to pass my earthly life
At focal point of plating strife,
Called by platers in their spite—
"Drone!", or "idle parasite,"
"Non-productive overhead,"
And other things—best left unsaid!

As all my working days are spent
'Twixt Scylla of the management
And Charybdys of plating vat,
I've turned into a diplomat.
I never answer "YES!" or "NO!"
But always—"WELL! THAT MAY
BE SO."
I write reports ten pages long
In ultra-scientific tongue
To hide all my deficiency
In prolix ambiguity,
And thus erect in self-defense
A facade of omniscience.

My instruments are very few,
A balance and a weight or two,
Titration flask and glass pipette,
Sampling tube and thickness jet,
No modern tools—no microscope,
No cathode-ray oscilloscope,
No chance to make discovery
That might win immortality
And earn for me a lasting name,
Instead, my every day's the same,
Thickness tests and routine checks,
Striving to avoid defects,
Trying to illuminate
The ignorance of those who plate,
And finding to my cost each day
That no one's heard of FARADAY.

Yet I'm proud that, but for me,
Our plating methods still would be
Wrapped around in mystery,
Anachronistic legacy

Of heathen craft or Voodoo rite.
Are not then my prospects bright?
One name I'm called I can't forgive,
A "PSEUDO-SCIENTIFIC SPIV."

The Sales Manager of Satanic Supplies Ltd.

I'm the villain of this piece.
Look! My palms are thick with grease.
Pray, excuse my opulence.
I earn more pounds than they do pence.
In fur-lined coat,—with fat cigar,
I drive around in Sheerline* car.
Let others toil,—I'll sit and spin
And sweep the cash and credits in.
My invoice charge I overstate,
But then—I underestimate
My promise of delivery.
And what about my quality,—
Ravelled mops, and gritty lime,
Anodes rotting into slime,
Tanks that leak and pumps that burst.
Filters! Evermore accursed!
Salts of doubtful purity
Are part of my sales policy.
For platers who are in a plight
Will turn to me put them right.
Ha! Ha! They're then such easy game,
That they'd buy chalk with fancy name,
And when I've thus turned bad to worse
They'll dip still deeper in their purse.
But life is short—it's time I took
Another order in my book.
And if it's "amps" that you require,
I've got a nice new rectifier.

** (This is The British equivalent of a Cadillac convertible. Ed.)*

(If any of our valued advertisers should read this—remember we're only foolin'. Ed.)

The Fairy

I'm the fairy "E.T.S."
Don't you like my ballet dress?
I wave my magic wand and then
Your troubles solved,—you're friends again.
A thousand platers owe to me
Allegiance and fraternity
At lecture or symposium
In London, Sheffield, dear old 'Brum.'
In '25 I first saw day.
Since then I've grown in every way,
And now at age of twenty-five
I'm very, very much alive.
So all together join with me
TO GREET MY SILVER JUBILEE.